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AUTOMOTIVE and Aviation INDUSTRIES

MARCH 1, 1944

In the Hellcat...

Vital parts of the Pratt and Whitney engine which powers the Grumman Hellcat are made of Bethlehem Aircraft Quality Steels.

BETHLEHEM AIRCRAFT QUALITY STEEL ☆ BETHLEHEM STEEL ☆

AUTOMOTIVE and Aviation INDUSTRIES

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There are many GOOD THINGS AHEAD . . .

One proposed use for obsolete war planes is for the quick freezing of foods. Cargoes of freshly picked fruits and vegetables may be flown directly from the fields to high altitudes. There the compartments will be opened and the contents immediately frozen by the intense cold.

More than 2,000 varieties of plants have been tested for rubber during the last year.

A resin bonded panel of plywood, with a sprayed coating of steel, has eight times the strength of either material alone.

Electronic hearing devices are now so sensitive that the growing noises of a blade of grass may be heard.

One use suggested for the Helicopter is to carry girders and beams to high buildings or bridges and hold them in place while they are being fastened. This would make derricks, elevators and cranes unnecessary for this purpose.

Magnets are being used by draftsmen to hold drawings in place on steel-cored drafting boards.

Three stages of post-war development in railway locomotives are predicted. First, the high-efficiency turbine, using super-heated steam at 600 to 700 degrees. Second, the oil-burning internal combustion turbine. Third, the same type of turbine with a gas-producer using coal.

A small hand tool now "spot-welds" thermoplastic resins electronically.

So rapid are changes in technology that, for purposes of government bookkeeping, synthetic rubber plants are assumed to become obsolete in five years.

Transparent plastic, reinforced with glass fibers, is being used in aircraft construction. The material is said to have ten times the impact strength of ordinary plastics.

For twenty years people have been laughing scornfully at the "seadromes", 65,000 ton, 10 million dollar islands for transatlantic passenger planes. Now that seemingly fantastic project is being seriously considered by several large steel, shipbuilding and air transportation companies. Supported on floats 160 feet below water and extending 70 feet above the surface, the seadromes are unaffected by waves and would furnish a safe, level landing and refueling place as well as luxurious hotel accommodations.

Steel alloys, whose exact compositions are unknown, can now be quickly identified by the use of a small radio-like apparatus.

The most powerful electric motor in the world has recently been completed. It develops 7,000 horsepower at a speed of 25 r.p.m.

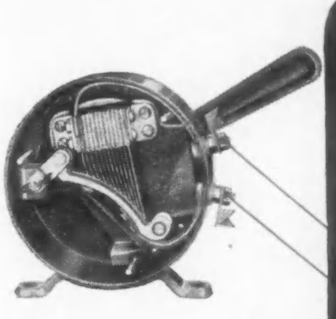
Seventy-two refineries are now making 100 octane gasoline, the production of which has increased 400% in the last year, and is expected to double again in the year ahead.

By the use of a new ultra-high frequency, resonator telephone engineers expect to send six-hundred thousand conversations or television pictures at one time through a six inch pipe.

A new balance will weigh as little as two-hundred millionths of an ounce. The pointer is so tiny that it must be read through a microscope.

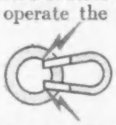
The carbon brushes used in the various electric motors of fighting airplanes are small, but vital. A new chemical process is reported to increase their life fifty times, and to prevent breaking down at the low temperatures in which they must operate at high altitudes.

Punched plastic sheets are now being used in place of cedar separators in storage batteries.



Why Warner Electric Brakes Give You
SPLIT-SECOND STOPPING POWER FOR YOUR HEAVY LOADS
—USE LESS CURRENT THAN A TAIL LIGHT!

• The Warner Electric Brake is a simple, mechanical brake, operated by an electro-magnet and armature disc. Each wheel is a complete brake unit. The power is built within the brake itself — a wire to the battery and a rheostat control are all that is needed to operate the brakes.

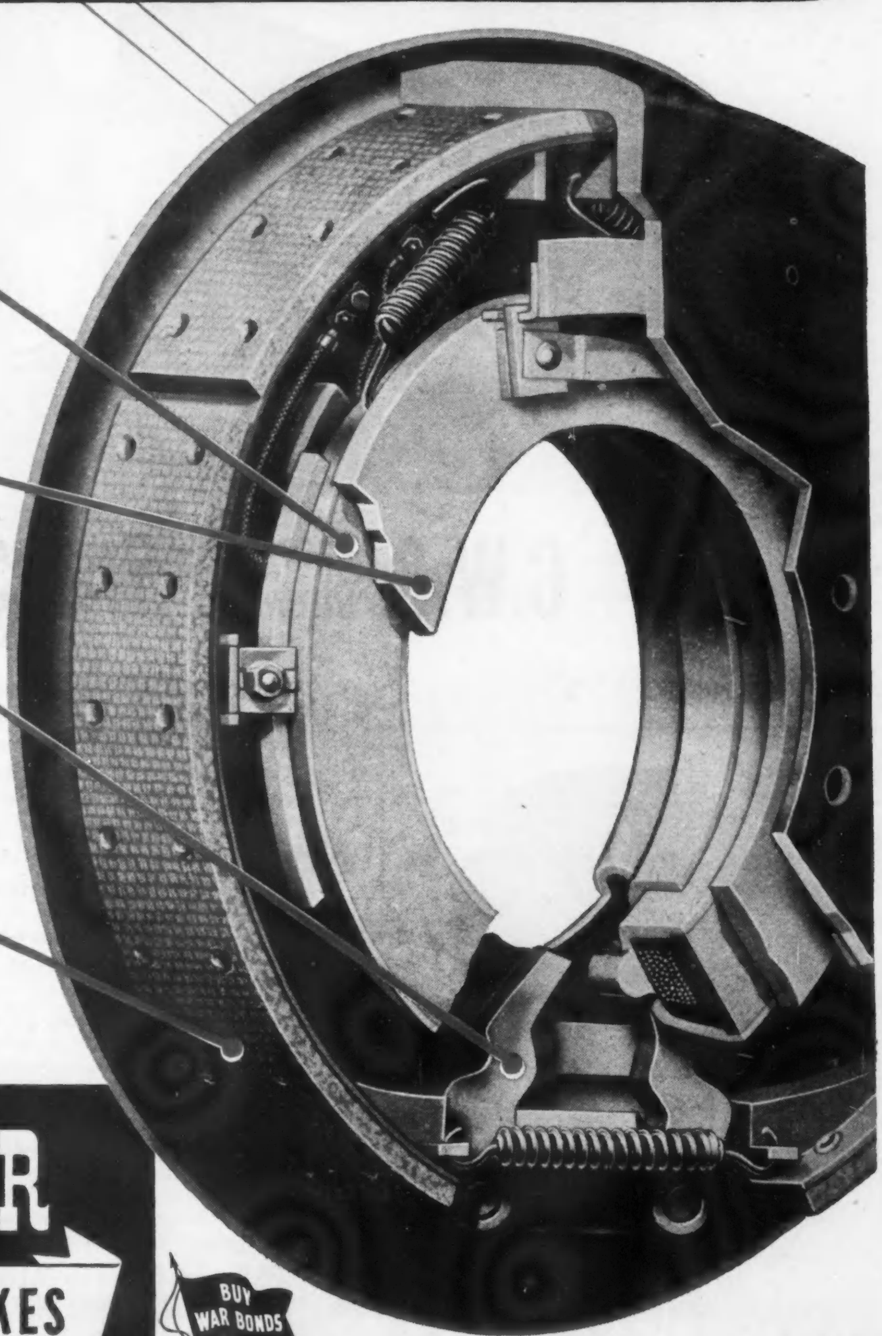


• The electro-magnet remains stationary within the wheel, until power is applied from the driver's seat.

• The armature disc revolves with the wheel. When the driver moves the controller lever the electric current energizes the electro-magnet causing it to cling to the revolving armature disc which shifts the magnet within a limited arc in the same direction as the wheel.

• As the electro-magnet shifts, a lug attached to the magnet presses a cam against the brake band end, forcing the brake band against the drum thus applying the brake.

• The more current the driver allows to reach the electro-magnet the tighter it clings to the armature disc. A slight slipping action prevents grabbing. No brake adjustment is necessary. Lining can be worn down to rivet heads — at which point a safety stop eliminates scoring of drums.



WARNER ELECTRIC BRAKES

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CAST OF ELECTRIC FURNACE ALLOYED METAL

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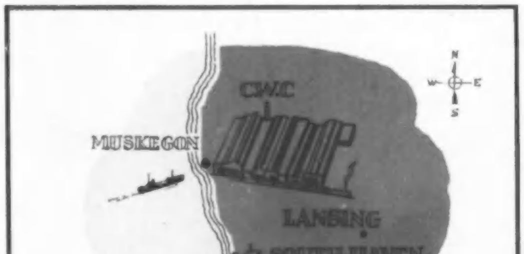
Proferall* *Cast* Crankshafts provide engine builders with complete freedom of design unrestricted by limitations inherent in crankshafts made by other manufacturing methods. In addition, cast crankshafts of electric furnace alloyed metal provide these advantages:

- *Improved bearing life.* Hardening of bearings is unnecessary for long uninterrupted service.
- *Tremendous savings in machine time.* Extreme accuracy in casting of cheeks and other dimensions make machining unnecessary except on bearing surfaces.
- *Counterweights cast integral* with crankshaft further reduces machining time and other production costs.
- *Important saving in weight.* The coring of main bearings and crank pins with a consequent saving in compensating counterweights provide a sizable economy in the original casting as well as in finished weight.

Proferall* *Cast* Crankshafts, during the past 10 years, have compiled a record of outstanding service under the severest operating conditions in every field—industrial, automotive, railway and marine. C.W.C. offers engine builders limitless opportunity for product improvement and production economy. Consult C.W.C. engineers and metallurgists freely about your crankshaft problems.

***PROcess FERrous ALLoy**



Campbell, Wyant & Cannon
foundries are located in Muskegon, South Haven (National Motor Castings Co.) and Lansing (Centrifugal Fusing Co.)
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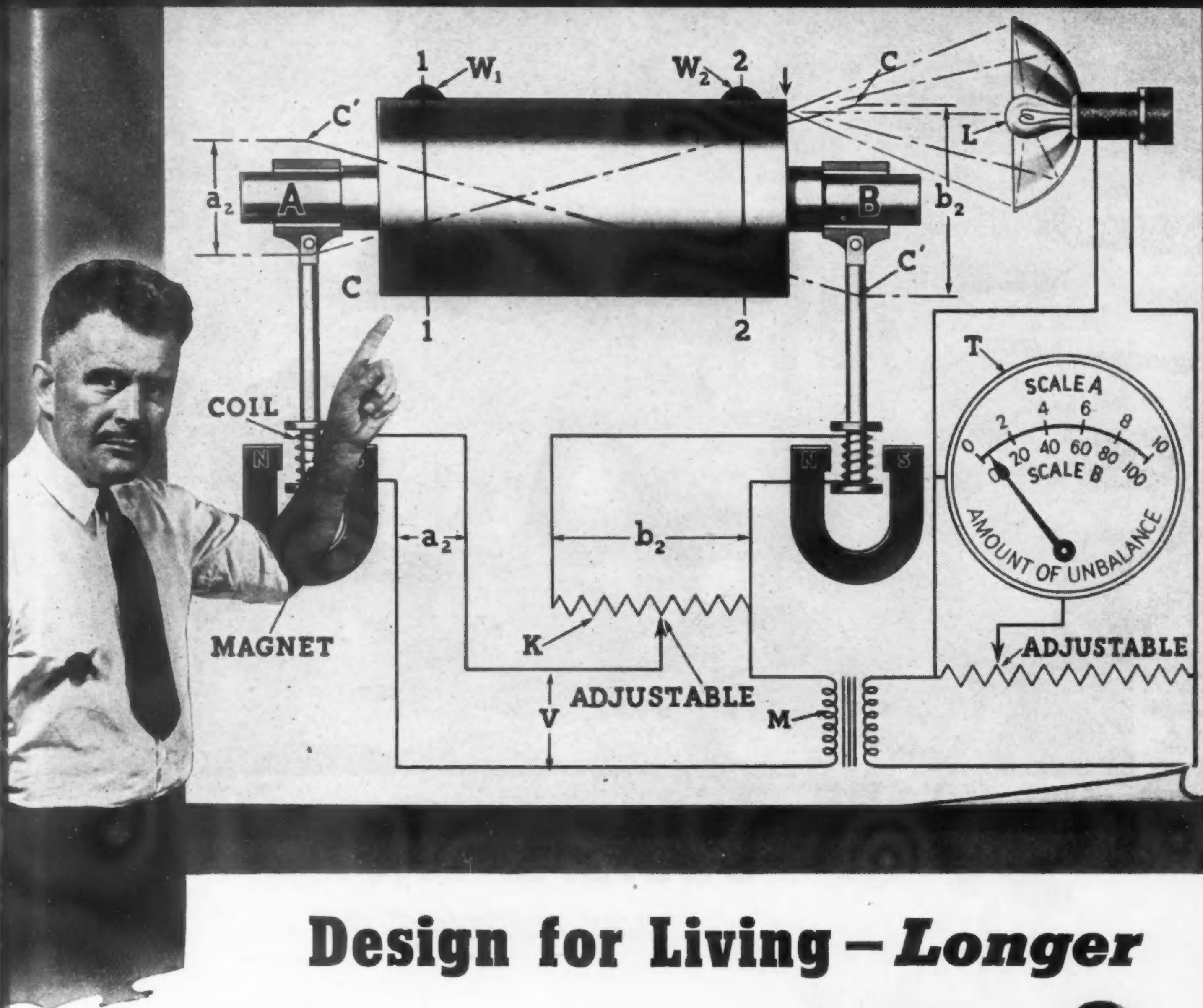

Design for Living – *Longer*

IF YOU'RE an electrical engineer, you'll see in this schematic diagram how the Gisholt Dynetric Balancing Machine *locates* and *measures* unbalanced forces by electrical means. If you aren't, don't let it bother you. Because the machine itself is so simplified that anyone can operate it.

The important thing is the way it can assure longer life in high speed rotating parts by eliminating vibration. It enables you to make accurate balance a *part of design* for smoother, more dependable operation. And it provides the quick and efficient means of insuring it. If your product involves the use of armatures, crankshafts, impellers, fans, pulleys, other high speed rotating parts, learn how Dynetric Balancing can help you.

GISHOLT MACHINE COMPANY
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LOOK AHEAD . . . KEEP AHEAD . . .
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has nothing on us!"
Says Stopper
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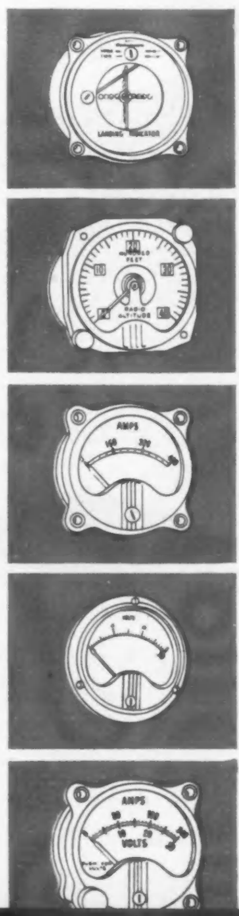
HOW WESTINGHOUSE SERVES THE AVIATION INDUSTRY

The Spring of everlasting youth



This is the spring that helps bring "blind" flyers home—sink lurking subs—blast enemy planes out of the sky.

Smaller in diameter than a pencil . . . made of special bronze alloy, it never "sets", retains its tension always. Used in Westinghouse instruments, it makes possible close calibration, and keeps that calibration uniform, permanently.

Made by a special process developed by the Westinghouse Meter Division, these tiny spirals are precision-made to extremely close tolerance.

Their structure is held absolutely uniform throughout their manufacture. Rigid torque inspections and individual tests assure correct tension characteristics.

These ageless springs are only one of many outstanding features of the complete line of instruments made by Westinghouse for the aviation industry. For additional information . . . help in solving your instrument problems, phone your nearest Westinghouse office. Or write Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., Dept. 7-N.

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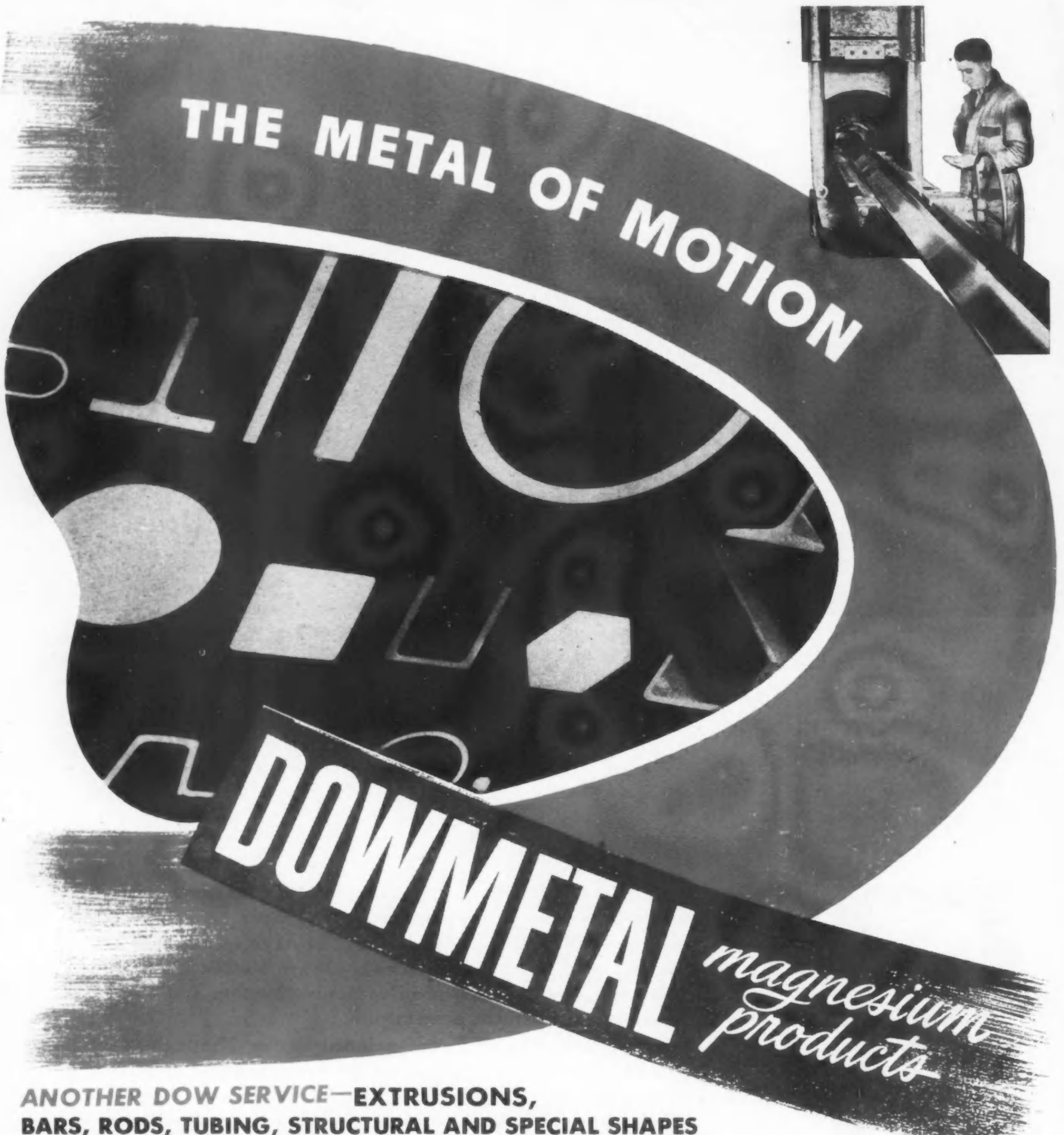

ANOTHER DOW SERVICE—EXTRUSIONS, BARS, RODS, TUBING, STRUCTURAL AND SPECIAL SHAPES FABRICATED TO MEET YOUR DEMANDS FOR LIGHT WEIGHT

● "Built-in motion" describes magnesium in action. For this lightest of all structural metals frees products of hampering, costly weight.

You may need magnesium—the Metal of Motion—and if your problem involves light weight, you probably do. We maintain complete fabricating facilities and equipment. Extrusions produced in Dow plants are available in a wide variety of shapes, ready for use. You can design special sections to fit the part needed. Dies for these shapes are relatively inexpensive, making small quantities entirely practicable.

Exceptional machinability makes rods and bars ideal screw machine stock. Magnesium extrusions have good surface finish and can be held to close dimensional tolerances.

Dow stands ready to help you use magnesium—backed by 27 years' experience of producing, alloying and fabricating the *Metal of Motion*.

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MAGNESIUM DIVISION—THE DOW CHEMICAL COMPANY, MIDLAND, MICHIGAN

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IN THIS ISSUE . . . .

AUTOMOTIVE
and AVIATION
INDUSTRIES

Volume 90 March 1, 1944 Number 5

AUTOMOTIVE INDUSTRIES

Reg. U. S. Pat. Off.

We Should Plan It This Way

By Frederick C. Crawford

ALL AMERICANS long for a better America. Today, through the sacrifice of war, they hope to build an America of opportunity, jobs and security. This better America must belong to all of us, not to any class or group or segment of our society. American people distrust all pressure groups. A program for a better America must benefit all.

As never before, the people need leadership—strong leadership, courageous, honest, bold and sincere. Through our war production, the American people have developed profound respect for the leadership of American industrial management in war industry.

Now, this leadership requires a very definite program. Industry has a program. It is a program for a better America. It is a program to provide—not merely to promise — but to produce the post-war America we all desire.

This plan means freedom for the American worker, freedom to quit one job for another, freedom to strive for higher wages, provided he contributes through greater efficiency an equivalent amount of production; the right for every worker to strive to become management or to own his own business.

This program means the right for capital, big and small, to invest, to risk savings in new enterprises; to back the inventor; the right to win or the right to lose; the right to possess a part of the increases that may come from wise risk investment.

This program means the right for American managers to plow profit back into the business in better machines, better methods, striving always for lower cost, so that goods may be sold cheaper to the American people, wages raised, and a larger return assured to capital.

This is the goal of the highest standards of living, full production, jobs with a full measure of opportunity and freedom. Only by producing more can we have more to divide. The source of all wealth, the source of the better America, is in greater production per hour of human labor.

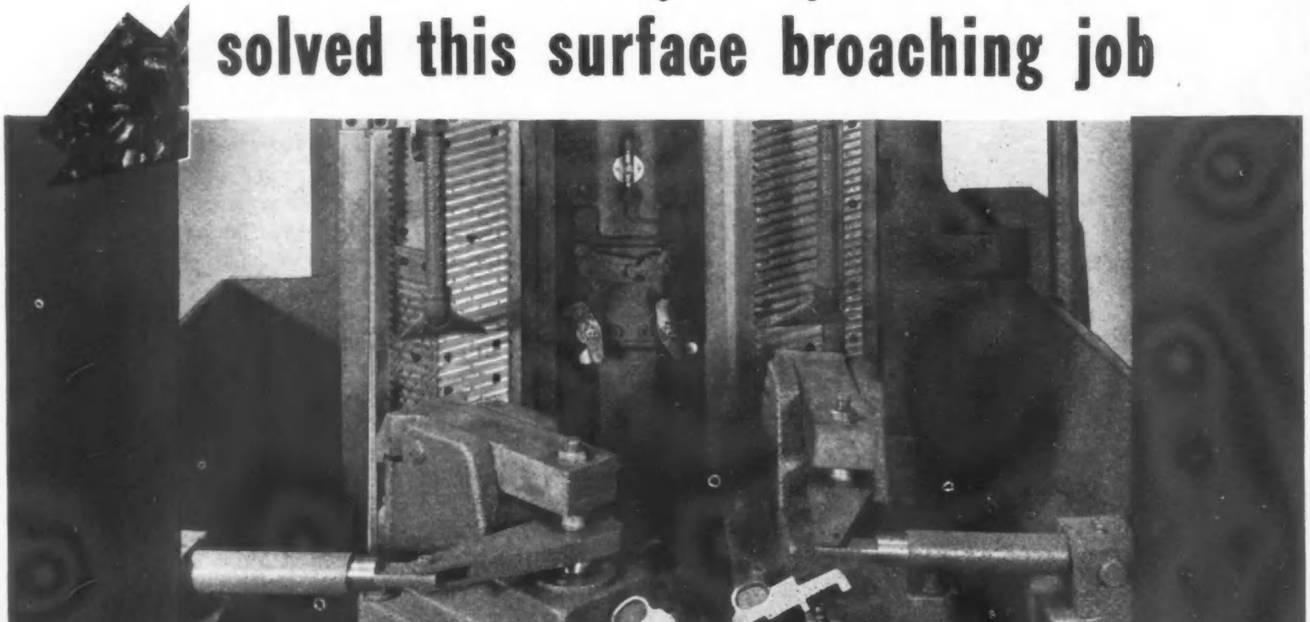
Industry's program offers the way to achieve this goal of full production under free choice—not just *a* way, but the *only* way. This way is to establish a system of free private competitive enterprise.

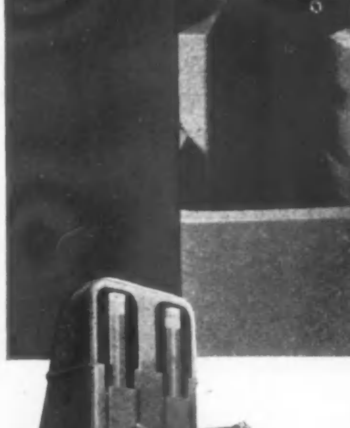
* From an address at the N.A.M. Second War Congress of American Industry.

ADEQUATE EXIT FOR CHIPS

immediately after formation

solved this surface broaching job





CINCINNATI No. 5-42 Duplex Hydro-Broach Machine. Complete data may be obtained by writing for catalog M-894-2. Brief specifications will be found in Sweet's catalogs file for mechanical industries.

Certain types of jobs, such as those requiring wide cuts with finished steps, present basic chip disposal problems at the point of origin. Primarily, the problem is one of getting rid of chips at the cutting edge as soon as they are formed. Without free and adequate exit, the chips will pack together in the tooth gullet, sometimes to the extent of breaking the teeth off the inserts.

The setup illustrated here, a CINCINNATI 5-54 Duplex Hydro-Broach with equipment engineered by CINCINNATI, is a good example of a highly successful installation which required a knowledge of the life and habits of chips. Both sides and the ends of the part are broached, and to further complicate the chip disposal problem, both sides include steps. Nevertheless, tool life is up to standard, and production averages 118 parts per hour (broached front and back)

Our engineers will be glad to apply their knowledge of broaching to your surface finishing problems. Send blue print and full information along with your request

CINCINNATI

AUTOMOTIVE and AVIATION INDUSTRIES

Published on the 1st and 15th of the month

March 1, 1944
Vol. 90, No. 5

The Metal Market After the War?

By W. C. Hirsch

REFLECTING clearly the effect of the ceiling price policy of our war cost control, formal termination of hostilities will in all probability find the quotations of key metals little changed from what they were when war was declared. These levels, it must not be overlooked, however, are not comparable in their character to values established through the free operation of the law of supply and demand. Following the end of military operations, extension of price control may be deemed necessary to cushion the national economy, delaying further the return of normalcy, but until buyers and sellers are again free to meet in the market place to agree on prices, unrestrained by regulations, not much more than an approximation of true conditions can be hoped for from a study of past transactions.

Labor relations being what they are generally, cost adjustments to permit of some upward revisions must be taken into consideration as a possibility, especially so in the case of steel, where the problem is now in the foreground of discussion, but such developments are not likely to greatly alter the broad pattern of the postwar metal market. It should be pointed out that by postwar metal market is meant the set-up that may be expected immediately following the war's conclusion and removal of wartime controls. What will happen once the needs of the period following the war have become sufficiently patent as to the tonnages that may be needed by the major consuming industries and the special properties demanded of each part, no one can foretell at present. Tied up as prospective metal consumption is with the when and how of the war's end,

Steel Industry Capacity

Data from American Iron & Steel Institute
(Net Tons in Round Figures)

1919 (End of World War I)	55,000,000
1935	78,500,000
1938	80,000,000
1941	85,000,000
1943	90,000,000 (Est.)

Finished Steel Production

Data from American Iron & Steel Institute
(Rolled Steel Output "For Sale", Net Tons in Round Figures)

1919 (End of World War I)	28,000,000
1935	27,000,000
1938	23,500,000
1941	62,000,000
1942	66,500,000
1943	67,500,000 (Est.)

Primary Aluminum Output

Data from U. S. Bureau of Mines (in Pounds)

1919 (End of World War I)	128,500,000
1935	120,000,000
1936	225,000,000
1939	325,000,000
1940	412,500,000
1941	615,000,000
1942	1,000,000,000
1943	1,840,000,000

Domestic Production of Magnesium

Data from U. S. Bureau of Mines (in Pounds)

1919 (End of World War I)	127,000
1935	3,000,000 (Est.)
1936	4,850,000 (Est.)
1939	6,700,000
1940	12,500,000
1941	33,000,000 (Est.)
1942	95,000,000
1943	370,000,000

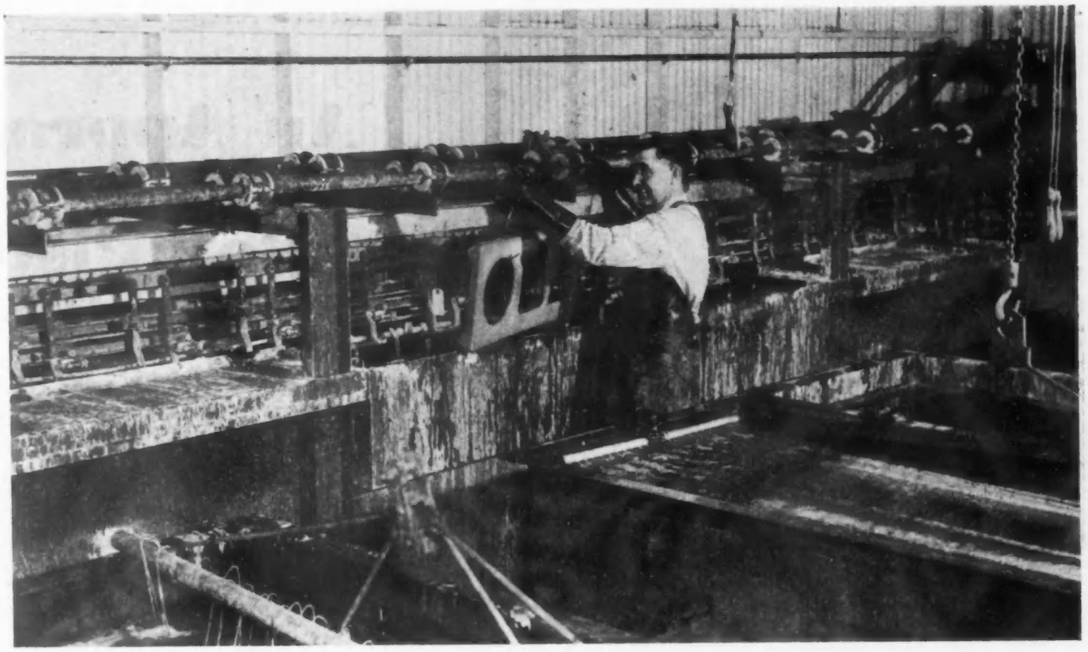
lack of crystallized opinion on that phase of the subject is hardly surprising. It is, however, possible to present a telescopic picture of what in the way of supplies the market is likely to afford.

With the one exception of tin, the least of the metal consumer's worries in the days immediately following the war is likely to be adequacy of supplies. Present steel ingot capacity of 95,000,000 tons a year is expected to be reduced to 90,000,000 tons through the elimination of unprofitable and obsolete plants, the output of which was needed as a war contribution. As against this, Walter S. Tower, president of the American Iron & Steel Institute points out that "actual experience never has produced a peacetime demand for steel as high as 65,000,000 tons of ingots." Of the recent yearly output approximately 13,000,000 tons were alloy steels, about four times annual prewar requirements. Electric furnace capacity, in prewar years ample for a million tons' consumption, is four times that today. Nor have additions to finishing mill equipment lagged behind primary facilities. The necessity of conserving as much as possible the supply of a number of alloy materials has broadened the uses of heat-treated carbon steels and fostered a better knowledge by automotive engineers of their properties and limitations. The postwar period is certain to develop clearer recognition of what is worthy of retention in the metallurgy of lean alloy steels and what can be placed more profitably in storage against that unhappy day when the Nation may again be confronted by the necessity of having to cope with such an emergency. Just as we are already becoming inured to the advisability of plowing under some war plants, the very existence of which might throw out of balance capacity and peacetime consumption, so we shall probably have to jettison much that looked as though it held the germ of technical progress, when under the light of cost analysis and comparison it appears impractical. Significant of the trend regarding steel evaluation among automotive engineers, thought veers more and more toward subordinating importance of a steel's chemical composition to its behaviour under physical tests. What steel will do, is the important factor, not what ele-

(*Turn to page 56, please*)

Base Metal Ceiling and Market Prices

	Ceiling Cents	Market Feb. 1, 1944 Cents
Aluminum, secondary	12½	11
Magnesium (99.8%) ingots	20½	20½
Copper, electrolytic	12	11⅞
Zinc, Prime Western, New York	8.66	8.66
Tin	52	52



Semi - automatic plating conveyor at Bell Aircraft Corporation. Parts are attached to the conveyor which carries them through the complete plating process. When the conveyor returns, operators remove the parts and attach others.

Protective Coating and Camouflaging of Airacobra Parts

By Emerson D. Lapsley
Factory Manager,
Bell Aircraft Corp.

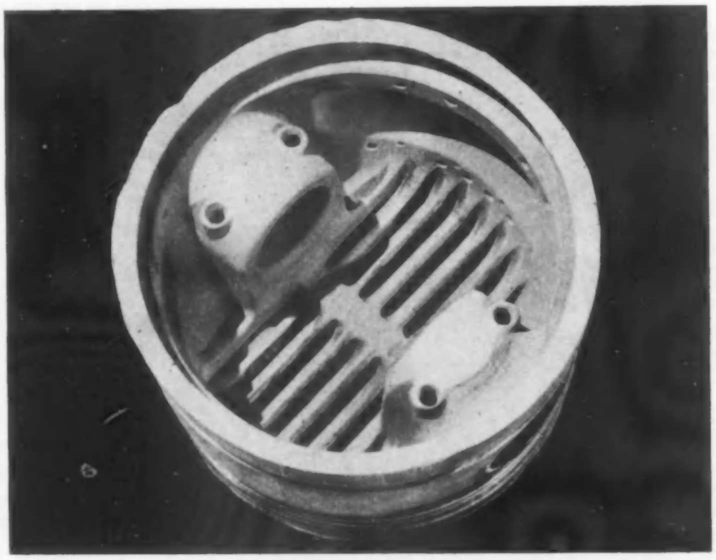
FURNISHING adequate protective coatings to construction units is one of the big jobs of an airplane manufacturer. A small fighter plane, for instance, has more than 9000 forged, cast and sheet metal parts and approximately 72,000 rivets which require "finishing" treatment. To keep this phase of manufacture on a par with the speeded up fabrication and assembly methods demanded the discarding of the old laboratory treatment in favor of a faster process. At Bell Aircraft Corp. the finishing of construction parts for the Airacobra has been developed to a point where chemical treatment of metal, painting and camouflaging has been streamlined by the utilization of conveyor systems, many of them new to the aviation manufacturing field.

Even a slight amount of corrosion cannot be tolerated where the lightest and strongest alloys available are used in a product from which every excess ounce of weight has been pared. Alloys used in the construction of the airplane fall into four main classifications, copper, iron, aluminum, and magnesium. In the matter of corrosion resistance, they rank just about as listed. Copper alloys have the highest rating and magnesium alloys the lowest.

The greatest per cent of weight in a modern military airplane is comprised of aluminum alloys, and where pure aluminum in itself is remarkably resistant to corrosive action, the aluminum alloy used in the airplane displays a marked decrease in resistance to corrosion. Pure aluminum does not possess sufficient

(*Turn to page 72, please*)

Completed Army P-39 Airacobra wing panel is suspended by a monorail while it is being prepared for painting. The monorail carries the wing panel through 16 stations of cleaning and metal preparation, and finally through two paint booths.



Piston from Mercedes-Benz DB 601N Engine of Messerschmitt Me 109F-2 fighter.

An Appraisal of Alloy Pistons in

IN A recent report the British Ministry of Aircraft Production gives a summary of the metallurgical data for a number of light alloy pistons taken from German aircraft engines. The investigation, which was made by the Research Metallography Department of a firm of specialists, High Duty Alloys Limited, was directed principally to determine the types of alloys in use in Germany and the general standard of quality adopted, and to obtain information relating to the methods of manufacture employed. The mechanical properties of each component were determined by using test pieces selected in relation to the direction of grain flow and the service to which the components have been subjected. Heat treatment and general quality have been assessed by metallographic methods. Certain conclusions are drawn on the basis of experience gained with British alloys and components, but no comparisons are made with such components.

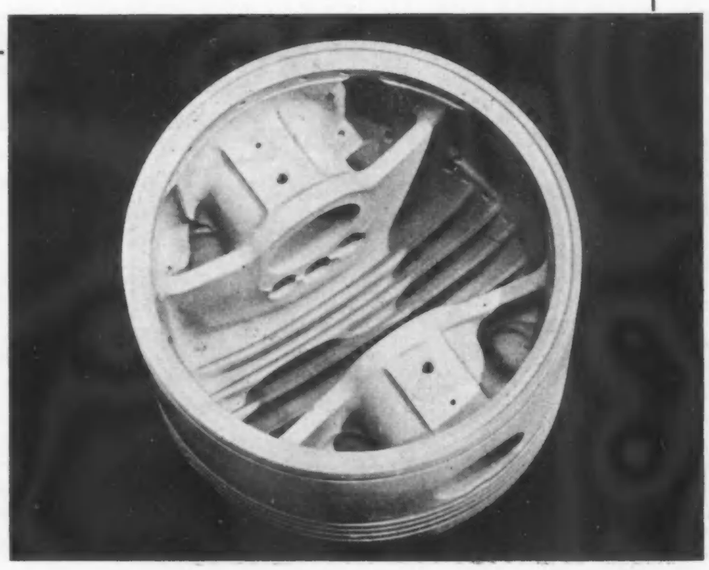
The report deals with seven pistons used in four engine types. These pistons were similar in that each had been produced to close internal limits, with the object of reducing machining time. In each case crown reinforcement had been obtained from ribs formed in the dies. Very little internal machining was necessary and the finish produced by the forming dies had evidently been considered to be satisfactory for duty under conditions of severe stress and high temperature.

With the exception of the piston from the Bramo-Fafnir engine, the material employed was of the eutectic silicon-aluminum type containing additions of copper, nickel and magnesium. The results of chemical analyses are given in Table 1.

The mechanical tests were carried out with test pieces obtained at selected positions to determine the effect of the operating temperatures on the properties of the material in each case. The results obtained

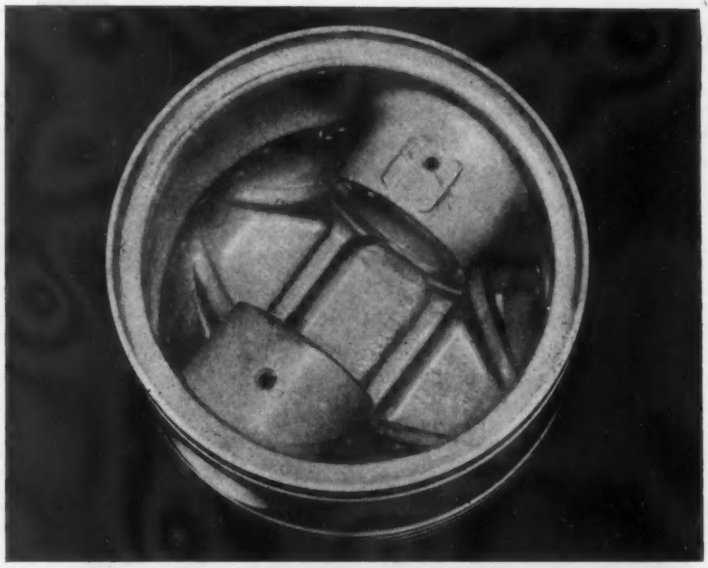
Table I—Chemical Composition (Per Cent) of Seven German Liters

Engine	CU	Ni	Mg	Fe	Si	Ti	Mn
BMW 132	0.82	0.91	1.08	0.53	12.04	0.09	0.04
BMW 801A-1	1.08	0.99	1.15	0.56	11.42	0.09	0.02
Mercedes-Benz DB601N	1.05	0.95	1.17	0.42	11.4	0.09	0.02
Mercedes-Benz DB601	1.09	1.15	1.06	0.71	11.65	0.12	0.02
Jumo 211F-1	0.97	1.05	1.30	0.42	11.4	0.03	0.04
Jumo 211A-1	1.02	0.93	1.16	0.43	11.7	0.08	0.06
Bramo-Fafnir 323P-1	3.54	1.75	1.37	0.36	....	0.07	0.01



Piston from BMW 801A-1 Engine of a Dornier 217E-1 bomber.

German Light Aircraft Engines



Piston from Jumo 211F1 Engine of Junkers 88 bomber.

By M. W. Bourdon
Special Correspondent of
AUTOMOTIVE *and* AVIATION
INDUSTRIES in Great Britain

at the base of the skirt or at the lower portion of the wrist pin boss usually provide a close indication of the original properties and by comparison the gradual deterioration to the center of the crown, normally the hottest zone of the piston, can be assessed.

The results shown in Table II represent the average of at least two tests. A further average of the results at position 4 indicates that the probable strength of the silicon-aluminum alloy was of the order of 46,200 psi ultimate tensile strength and with an elongation value of 3 per cent.

As considerable softening of the material takes place at the crown of a piston during service, when hardness tests are carried out on a cross-section a marked hardness gradient between the crown and the skirt is observed. It is generally found that at the base of the skirt the material suffers only slight deterioration in hardness and from this value an indication of the original hardness of the piston can be obtained. Values within the range 90-120 Brinell were given by the samples in the silicon-aluminum alloy.

By relating the hardness values obtained by a careful survey on a cross-section of a piston with the mechanical test results and the general struc-

(Turn to page 54, please)

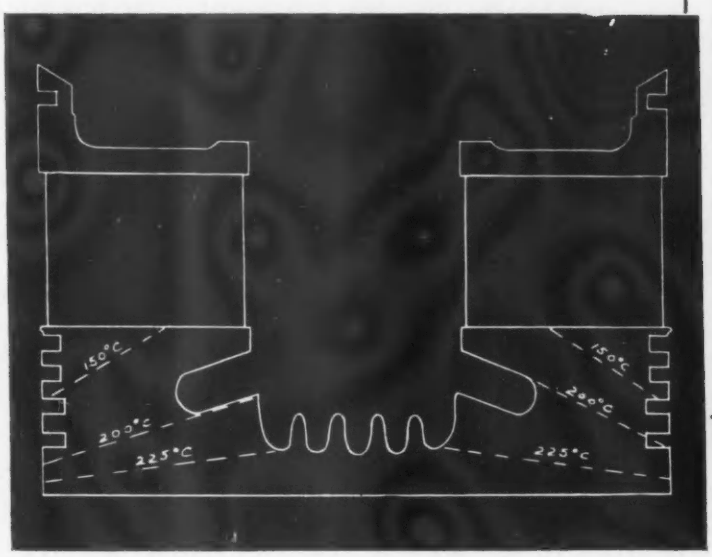
Table II—Physical Properties of German Piston Alloys

Position of Test Pieces

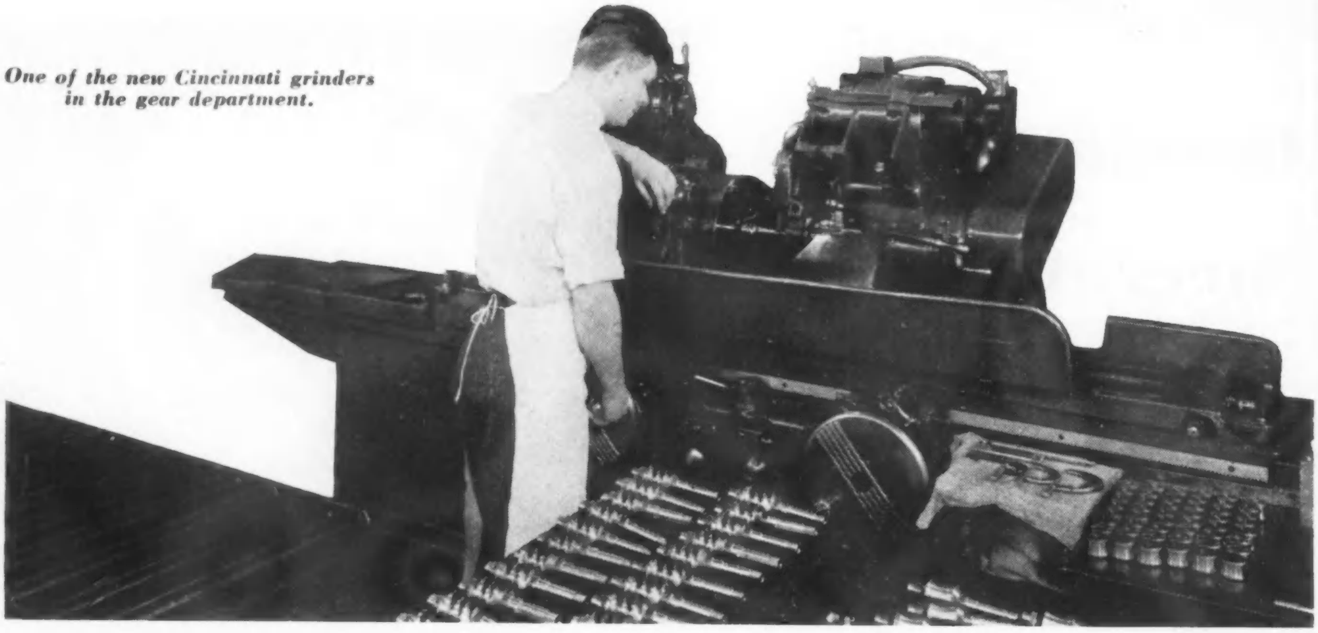
Position 1..Center of crown.
Position 2..Wrist pin boss, normal to crown.
Position 3..Wrist pin boss, parallel with crown.
Position 4..Lower skirt, or lower wrist pin boss.

Engine	Position	Yield Point x (psi)	Ultimate Tensile Strength (psi)	Elongation % (4)
BMW 132	1	22,900	31,000	7.0
	4	39,200	45,000	3.5
BMW 801	1	25,300	33,400	5.5
	2	35,800	41,800	3.0
	1	19,600	28,200	9.0
Mercedes-Benz	2	24,000	31,000	4.0
DB 601N	3	27.700	34,100	3.5
	4	35,200	42,900	2.0
Mercedes-Benz	1	30,400	35,400	3.5
DB 601	3	37,200	40,300	2.8
	1	22,200	29,300	6.0
Jumo 211A-1	3	....	40,700	2.5
	4	50,600	53,300	2.5
	1	24,200	30,200	3.5
Jumo 211F-1	2	38,500	40,900	2.5
	3	33,700	38,000	3.5
	4	40,300	43,800	3.5
Bramo-Fafnir	1	28,600	42,700	11.7
	3	33,000	43,400	6.8
323P-1	4	51,600	58,700	8.0

x Approximates to 0.2 per cent proof stress.



Estimated isothermals in piston from BMW 801A1-Engine.

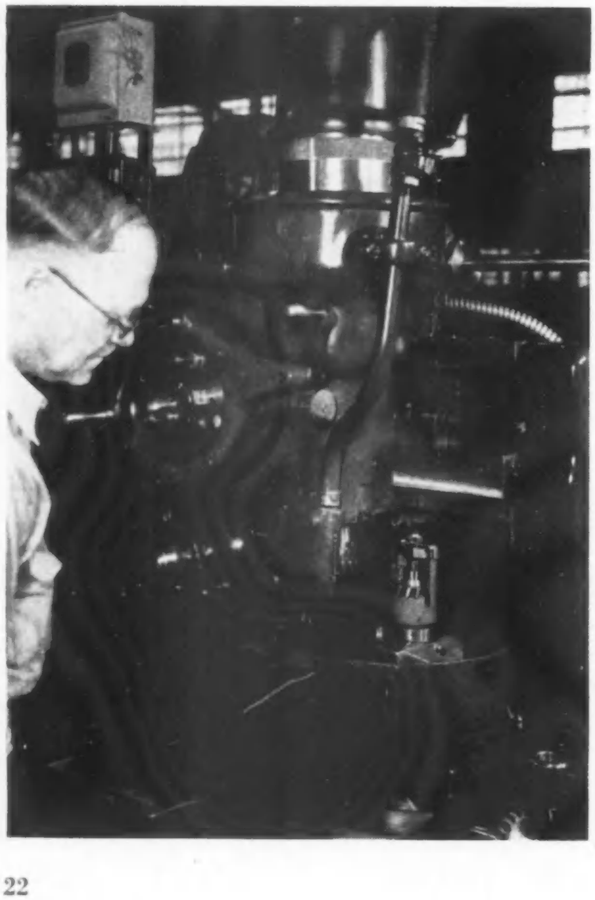


One of the new Cincinnati grinders in the gear department.

Other War Products with Steering Gears Enables

Gemmer to Utilize

By Joseph Geschelin



Latest addition to the gear department is this Fellows gear shaper.

ALTHOUGH known as one of the largest producers of passenger car steering gears, the Gemmer Manufacturing Co. has been supplying steering gear equipment for other applications including motor trucks, buses, agricultural tractors, road machinery, motor boats, industrial trucks and tractors. It is significant that in the conversion to war production, Gemmer accented the manufacture of heavy duty steering gears to a degree unusual in its past history, thereby laying the groundwork for specialization in heavy duty equipment for the future.

Since the volume of heavy duty steering gears could not possibly maintain the passenger car production facilities at the accustomed pace, Gemmer undertook the manufacture of a number of war products quite foreign to its normal activity. Among these are—the production of 40-mm shot; a Cone worm gear set; gear for bomb hoist; and an aileron control unit. Each of these products has been established in a small self-contained department, although many of the components are produced on the same machine lines as are steering gear parts.

Flexibility is the outstanding characteristic of this plant. Much of the machine tool equipment is of general purpose type, making it possible to run a wide

variety of parts over the same lines simply by changing fixtures and tools. The only exceptions to this, in normal practice, are several high production lines which are tooled for one type of steering gear in the interest of great productivity. Generally speaking, the plant is equipped with a variety of drill presses—Baker heavy duty, Natco multiple-spindle, Cincinnati, and other types; Sundstrand lathes; Cincinnati plain grinders, centerless grinders, and centerless lappers; Norton grinders and hyprolaps; a large battery of Cone automatics; Landis Machine Co., automatic turning and threading machines of two-spindle type; Lees-Bradner and Cleveland gear cutting machines; Lo-Swing lathes; and a variety of other makes and types.

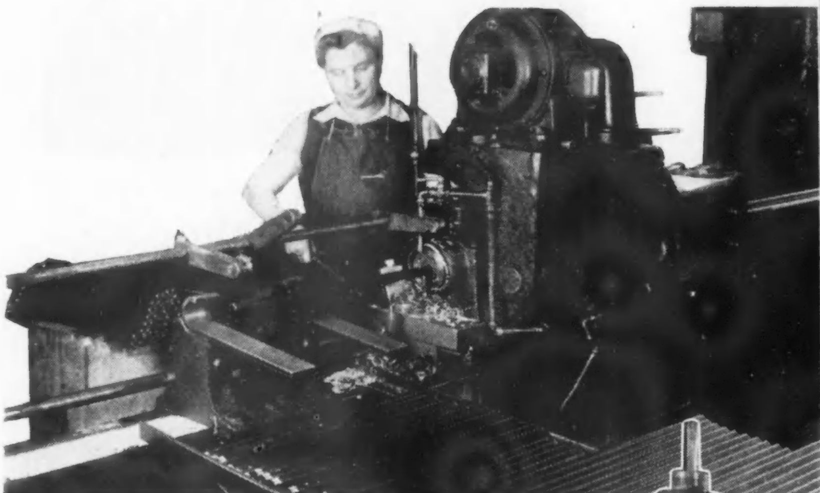
These facilities are supplemented by a small forge shop including an upsetter, forging presses, and a large heat treating department comprising a variety of equipment such as Ajax salt bath furnaces, Homo drawing furnaces, etc.

Materials handling is well organized in keeping with the character of the operation. Here will be found roller conveyors on specialized lines; a series of mechanized table height assembly conveyors for the sub-

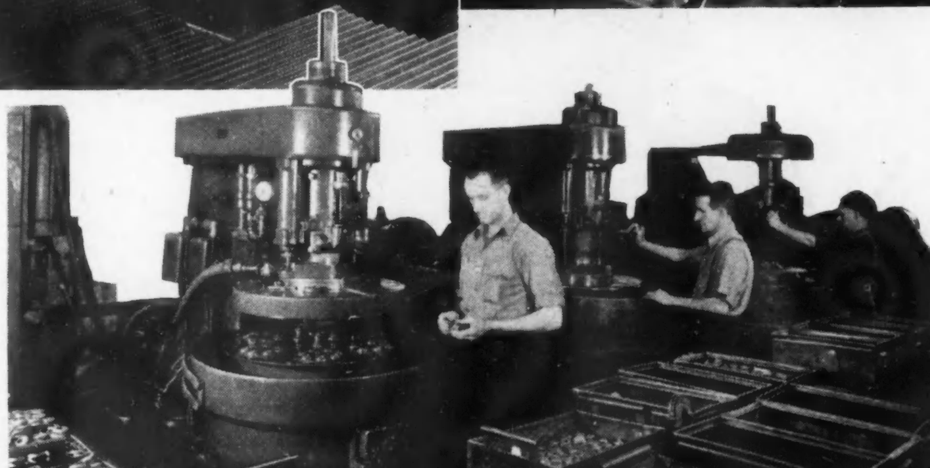
This is the Ninety-first in the series of monthly production features

Facilities

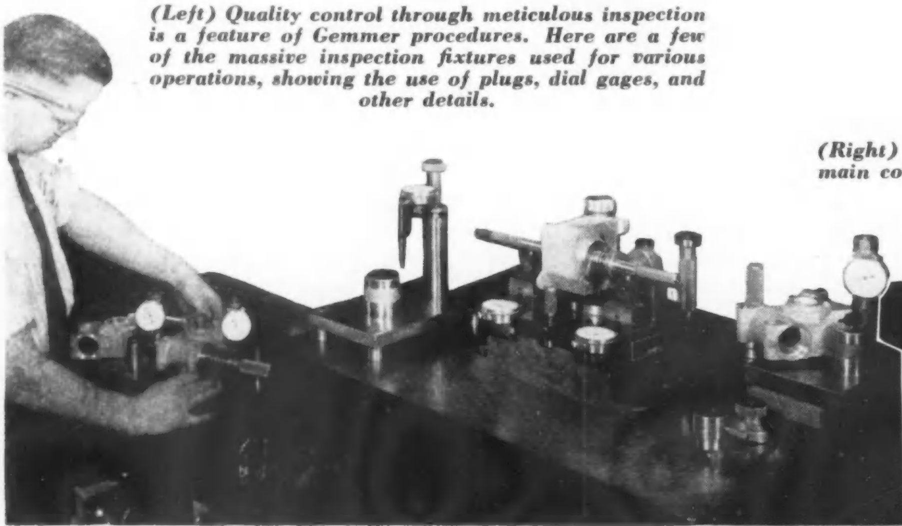
Unique method utilized here is the turning and forming of the stem end of the gear shaft in a double-head Landis threading machine, fitted with special die heads.



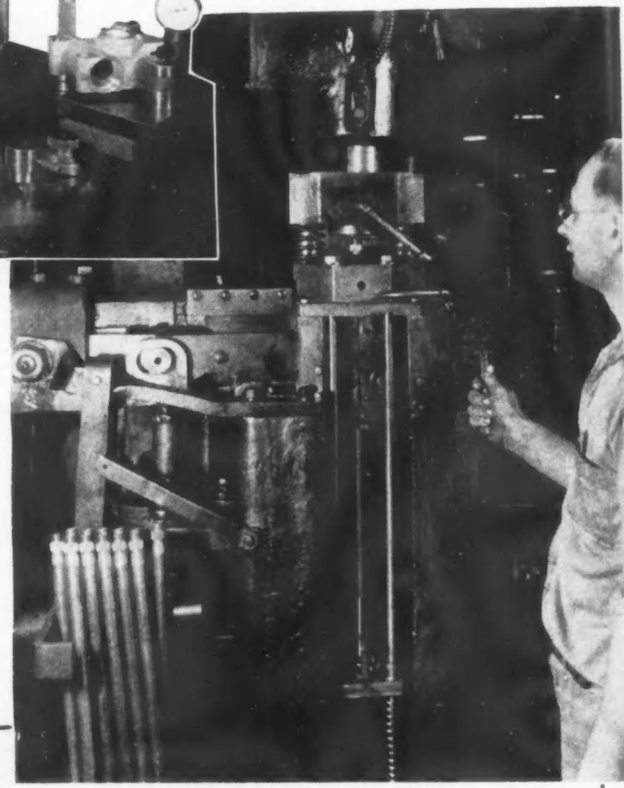
(Above) Main column is cut to length on this Bardons & Oliver cut-off machine.



(Right) Mirror finish of roller tooth faces and thrust washers is produced in these Norton Hyprolap machines.



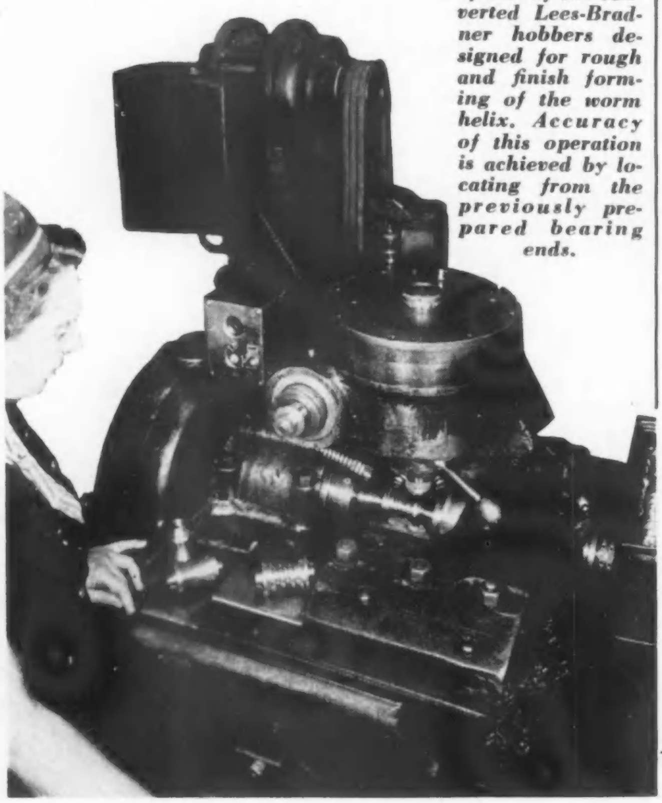
(Left) Quality control through meticulous inspection is a feature of Gemmer procedures. Here are a few of the massive inspection fixtures used for various operations, showing the use of plugs, dial gages, and other details.



(Right) Serrations or knurls on the end of the main column are produced with shearing dies, using a Fox press.

assembly and final assembly of steering gears; and a closed chain monorail conveyor for steering gear final inspection and adjustment. Much of the movement of raw materials and finished parts is handled by a small fleet of Clark industrial trucks and tractors.

Quality control plays a vital role with Gemmer. Many important dimensions and related surfaces of individual parts are controlled by checking with specially designed inspection fixtures. These are



This is a close-up of one of the converted Lees-Bradner hobbers designed for rough and finish forming of the worm helix. Accuracy of this operation is achieved by locating from the previously prepared bearing ends.

Factory Routing
Worm L. H.

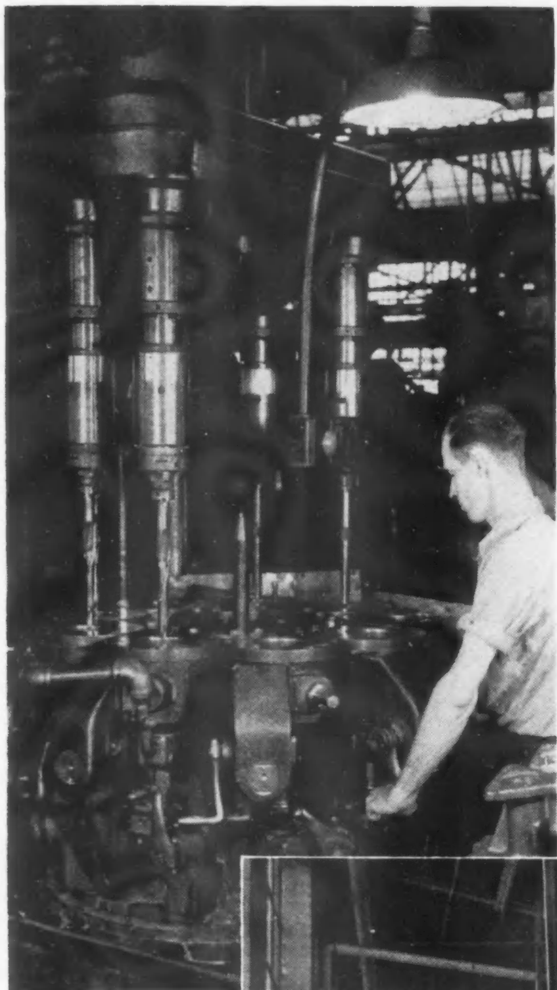
OPERATION	EQUIPMENT
Drill thru, form radius, rough form bearing seats, ream thru and cut-off	Cone Automatic
Finish ream two diameters	Drill press
Spline broach hole and key	Colonial vertical broach
Remove burrs from one end	Bench
Cut relief and finish form bearing seats	Sundstrand lathe —Arbor press
Stamp for identification	Punch press
Rough and finish form helix	Hobbers
Remove sharp edges at ends of worm	Engine lathe
Polish rail	Polishing machine
Inspect	
Heat in cyanide, quench in oil and wash in cyanide water	Cyanide pots
Draw	Homo furnace
Dip, wash and rinse	3 tanks
Wire brush	Gardner polishing lathe
	Acme auto polishing machine
Rockwell rail	Rockwell tester

of massive construction and are provided with direct reading indicator gages. For other important operations the well-known Sheffield Shadow gages are used, while on the 40-mm shot line they have one of the latest type Sheffield Multichek gages for checking all of the significant dimensions of the shot simultaneously.

Receiving inspection is handled by an outstanding procedure. All incoming ,raw materials and purchased parts are routed through

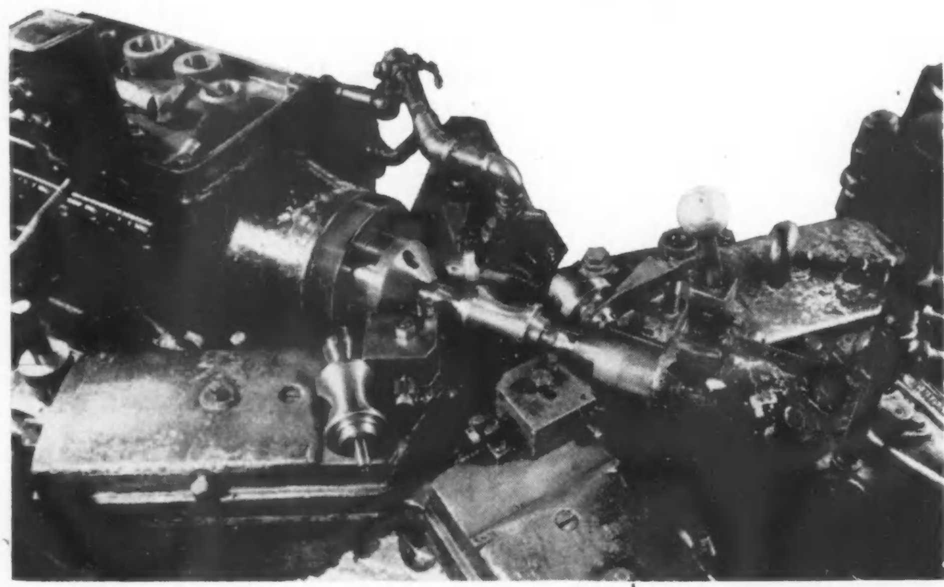
Factory Routing Gear Shaft R. H.

OPERATION	EQUIPMENT
Normalize	Rotary furnace
Tumble and shotblast	Wheelabrator tumblast
Brinell test	Brinell testing machine
Inspect forging	
Face long bearing to finish length	Barnes drill
Broach top of fork and end to dim.	Foote-Burt broaching machine
Rex mill thread dia., clear, taper and chamfer end	Baker 8-spindle machine
Turn long bearing face thrust and snap gage long bearing 100 per cent	Landis double-head machine
Grind long bearing and thrust to broach size and ring gage	Cincinnati Centerless
Rough and finish broach inside of head	Colonial broach
Broach inside of fork	Foote-Burt double broach
Hob serrations	Cleveland hobber
Cut threaads and ring gage 7 per cent	Double Landis threader
File burrs from inside of fork	Bench
Drill ream countersink 2 holes in fork	Ex-Cell-O-Drill
Remove all burrs	Wire wheel
Line ream 2 holes in fork	Motor driven spindle
Heat in cyanide, quench in oil, degrease, wash, dry and draw in nitrate	Ajax Hultgren bath furnace
Unload draw oven	Draw oven
Dip, wash and rinse	2 tanks
Rockwell	Rockwell machine
Finish grind long bearing and thrust	Cincinnati centerless
Grind inside of fork	Thompson hydro-grinder
Grind for mirror finish	Cincinnati centerless grinder
Wash and Air blast	Washer
Wash and steam	Washer
Select roller and shims, assemble to shaft and drive in pins	Bench
Electrically rivet pin both sides and demagnetize shaft	Upsetting machine
Inspect	



(Above) One of the high production, multiple-tool set-up for machining housings. This type of tooling is applied on Baker heavy-duty drills.

(Right) General view in steering gear assembly department featuring the monorail conveyor which serves the final inspection and adjustment stations.



Another unique machine set-up is found on Sunstrand lathes which have been fitted with special tool blocks for finish forming the bearing seats and annular relief on the ends of the worm. This is an extremely critical operation since it controls the alignment of the worm at final assembly.

Factory Routing Housing R. H.

OPERATION	EQUIPMENT
Spotface and chamfer upper end for locating diameter and chamfer lower end	Excelsior drill—Canedy Otto drill
Mill locating spot on trunnion	Hand milling machine
Core drill face cover, face and thrust and core drill and ream trunnion	Baker drill
Straighten frame pad	Fixture
Chamfer 2 ends and counterbore trunnion	Cincinnati drill
Spotface frame pad	Baker drill
Press in and burnish 2 bushings	10 ton press
Crossbore	Baker drill
Hollow mill upper end and drill clearance	Baker drill—Rockford drill
Drill and tap 8 holes	Fox multiple drill
Drill and tap oil filler plug hole	Fox multiple tapper
Drill 3 holes in frame pad and remove burrs from frame pads on both sides	Garner tapper Cincinnati drill
Remove all burrs, chamfer, counterbore, end and assemble oil filler plug	R & S Tapper
Inspect	
Wash and air blast	Washer

this department, traversing a system of roller conveyors which serves as a temporary storage line. Here each piece is examined and checked for acceptance in accordance with specifications, using instrumentation for dimensional tolerances, for hardness, etc.

From the management standpoint, the layout of the plant is extremely interesting. Save for the small areas that have been converted to other war products, the general scheme of the layout is to start raw materials along one wall, feeding to production departments running at right angles to this bay and terminating at the opposite wall. The arrangement of machine shop departments is such as to have the steering gear assembly components available at approximately the point of usage at the sub-assembly and final assembly lines. In keeping with this layout, the incoming raw materials and purchased parts come in on a spur track which traverses one side of the building while finished assemblies leave at the other side which is served by a ramp for motor trucks.

Perhaps the best way to visualize the manner in which parts production is handled here is to examine the factory routings on a few selected parts. These have been reproduced elsewhere in this article. Among the major components of the steering gear are parts such as—the column, the worm, the cross shaft, and the housing. Each one incorporates considerable novelty in its fabrication. Production men will be particularly impressed with the skill in which many

(*Turn to page* 58, *please*)

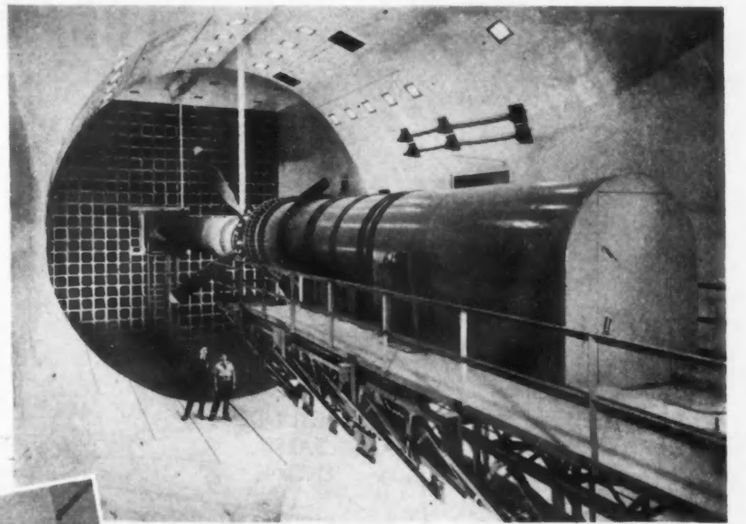
One of the features of Gemmer construction is the riveting and upsetting of the pin which serves as the pivot for the roller assembly. This operation is performed in the special resistance welding machine shown here.

Curtiss-Wright's

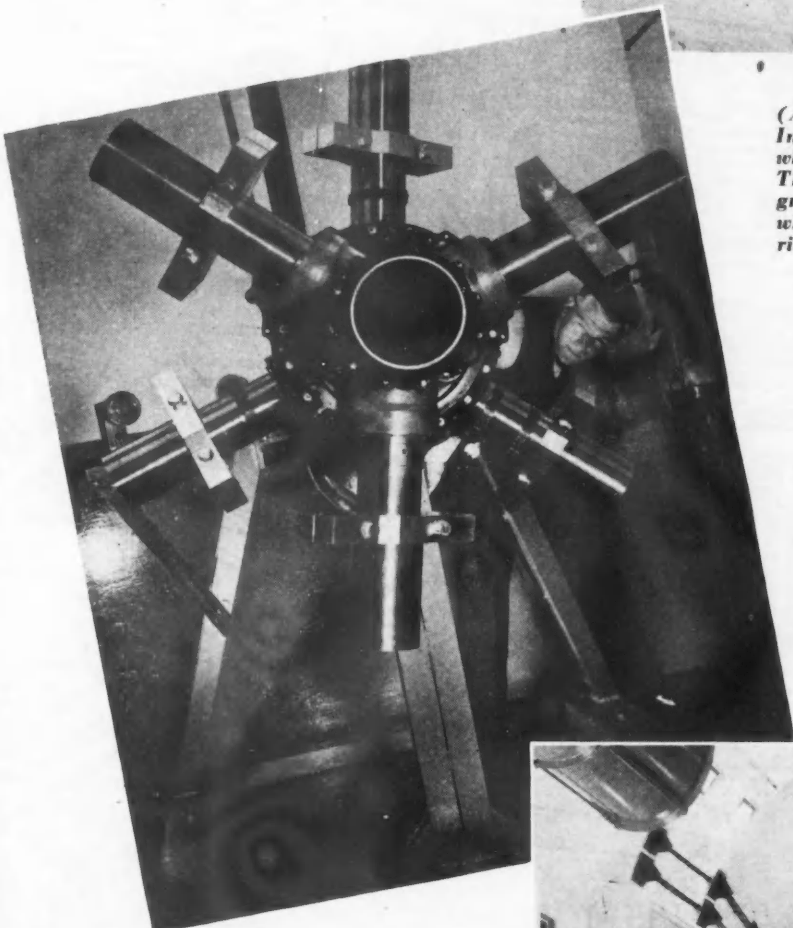
New Propeller

Test Cells and

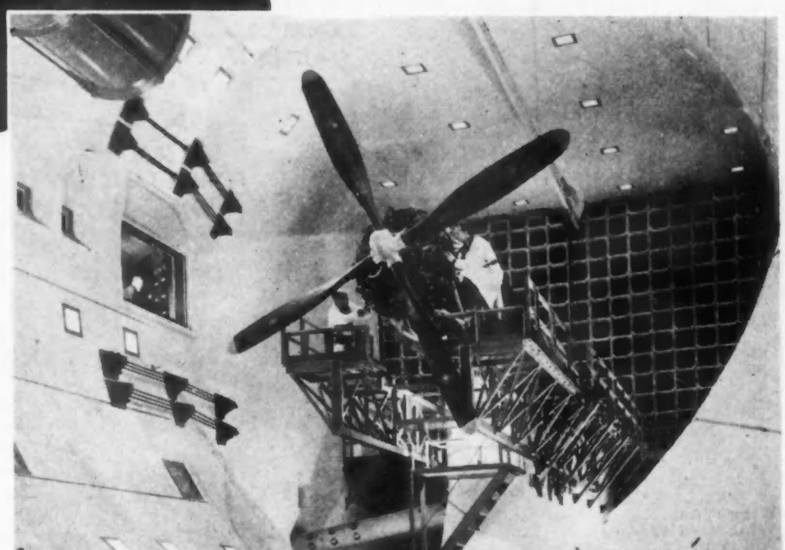
Laboratory



(Above) Another view of a Curtiss-Wright test cell. In the foreground is the steel tube or "boiler" on which is mounted a Wright Cyclone engine. Through it passes the power lines. In the background is the 48-in. jet cooling tube, inside of which is a cone that spreads the air into annular ring form. A flow of about 80,000 cfm is possible.

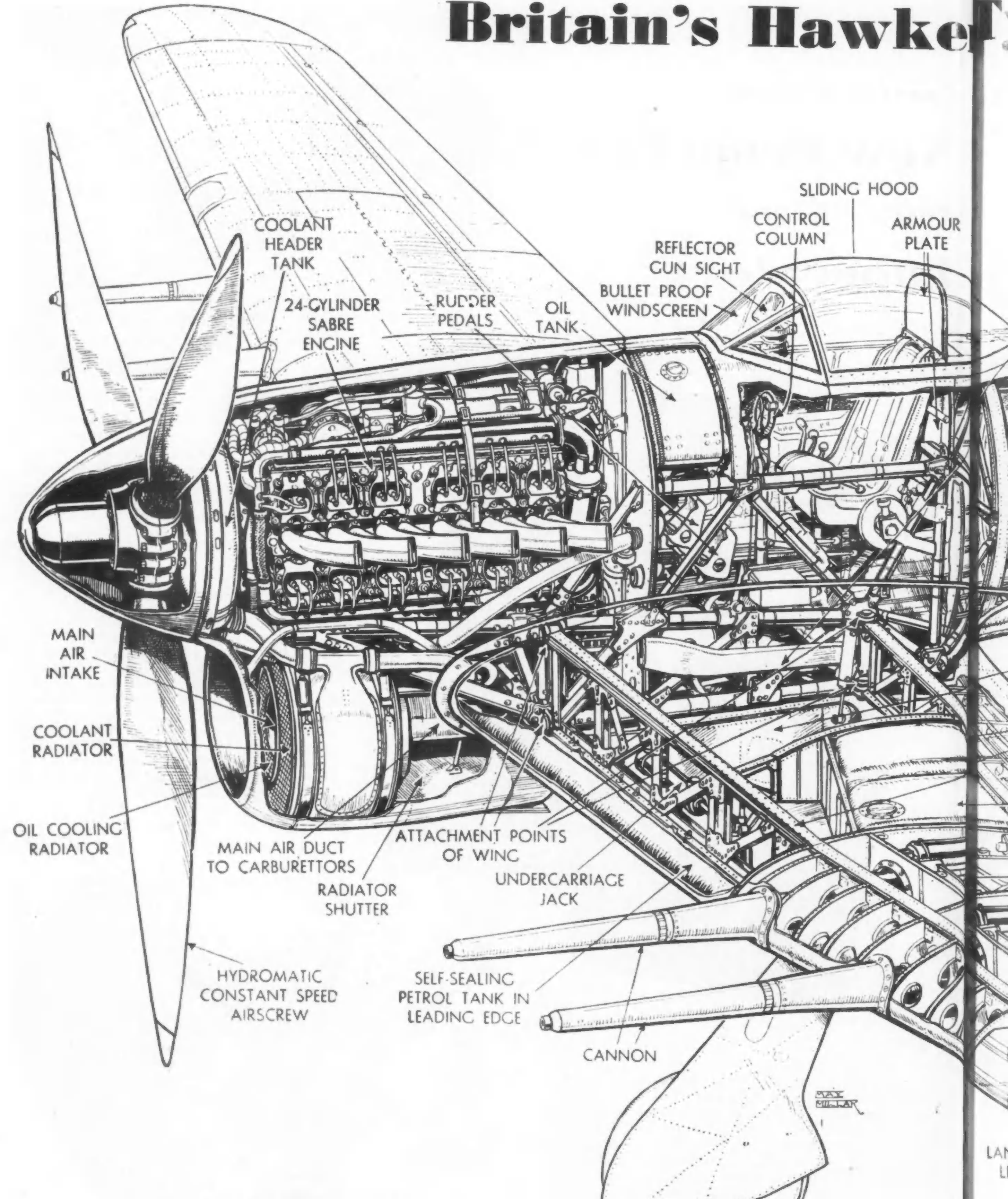


(Left) At the new Experimental Engineering Laboratory of the Curtiss-Wright Propeller Division an engineer is checking the alignment of counter-weights attached to the blade stubs of Curtiss dual rotation propeller mechanism about to undergo a whirl test. These counter-weights are applied to simulate the twisting moment under actual operating conditions. This laboratory is equipped with electronic vibration and other apparatus for testing propeller components



(Right) One of the two propeller test cells just completed by the Propeller Division of the Curtiss-Wright Corp. at Caldwell, N. J. Each will accommodate propellers up to 30 ft. dia. and air-cooled or liquid-cooled engines of 5000 hp. and over. At the upper left is the control room located between the two cells and equipped with instruments for recording the engine-propeller characteristics.

Britain's Hawke



SPECIFICATION DATA

Wing span	41 ft 7 in.
Wing area (gross)	279 sq ft
Tail span	13 ft
Length (overall)	31 ft 11 in.
Undercarriage track	13 ft 7 in.
Engine	Napier Sabre
Armament: Mark 1A	Twelve .303 Browning machine guns
Mark 1B	Four 20-mm Hispano cannon
Weight (loaded, including two 500 lb bombs)	12,000 lb.

Typhoon Fighter-Dive Bomber

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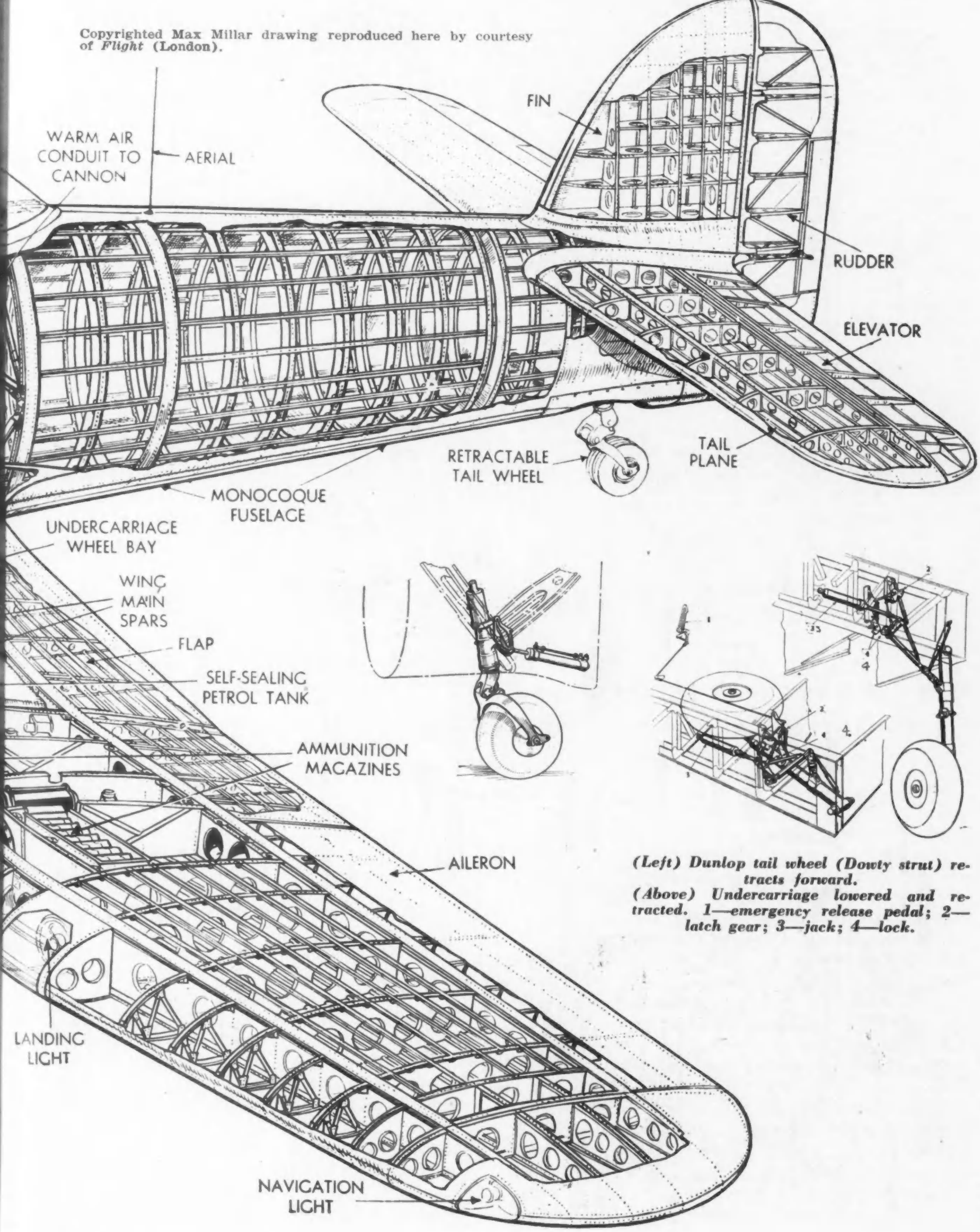
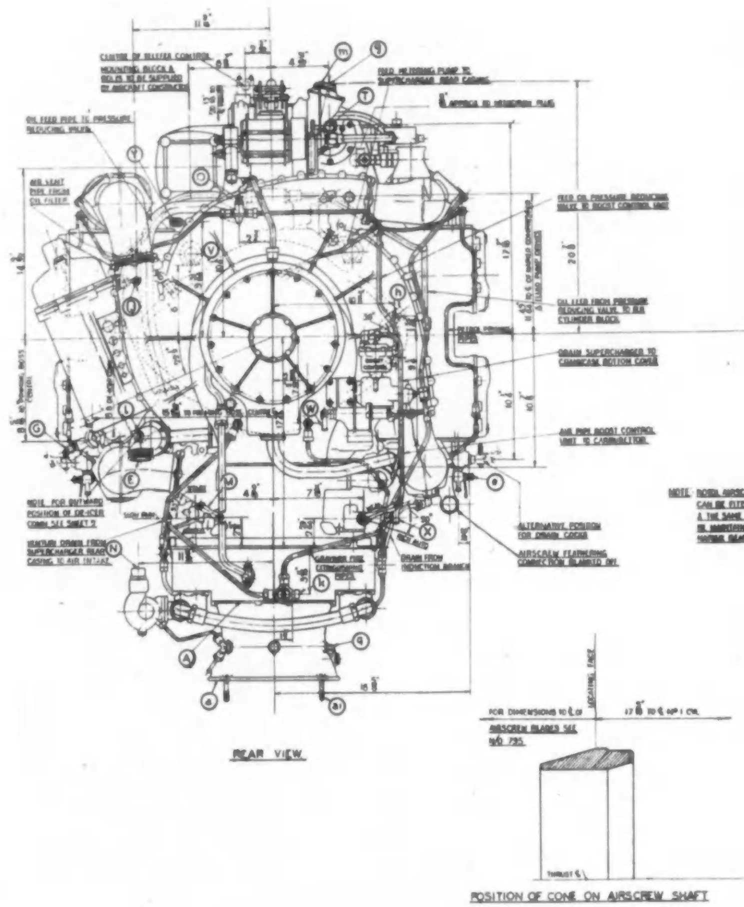
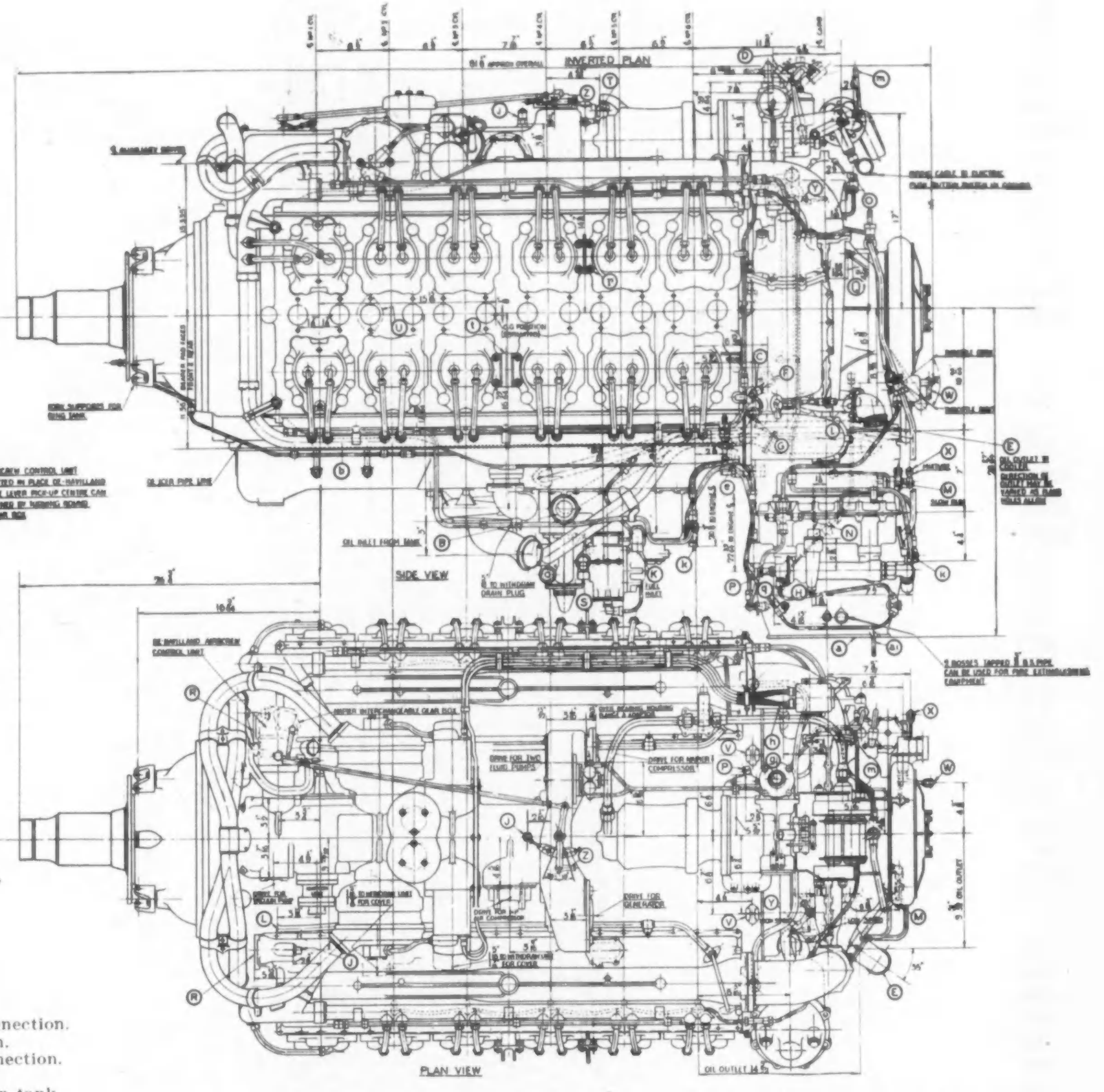


(Left) Dunlop tail wheel (Dowty strut) retracts forward.
(Above) Undercarriage lowered and retracted. 1—emergency release pedal; 2—latch gear; 3—jack; 4—lock.

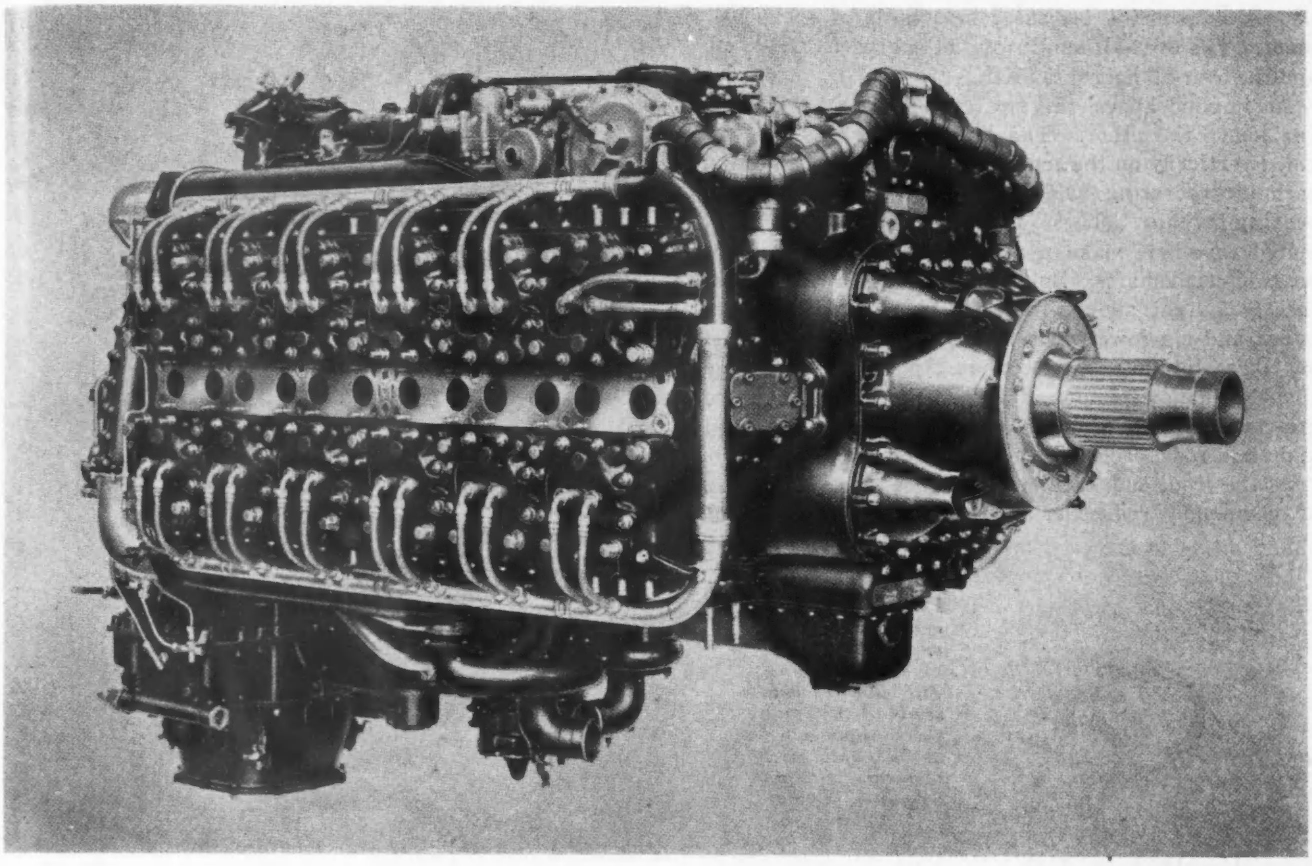




Napier Sabre Engine

A—Air intake face carburetor.
B—Oil inlet from tank.
C—Oil filter high pressure gage.
D—Socket for hand turning lever.
E—Oil outlet to cooler.
F—Oil tank overflow.
G—Oil priming connection.
H—Drain plug fuel inlet to carburetor.
J—Thermometer connection.
K—Fuel pump inlet connection.
L—Steam vent from coolant manifold connection.
M—Slow run control lever.
N—Fuel regulator inlet connection.
O—Fuel priming connection.
P—Fuel pressure gage connection.
Q—Boost gage connection.
R—Coolant outlet to header tank.
S—Fuel pump outlet connection.
T—Revolution indicator drive.
U—Exhaust flange.
V—Lifting eye crankcase rear end.
W—Throttle control lever.
X—Mixture control lever.
Y—Two-speed supercharger control lever.
Z—Airscrew control lever.

a—Air intake face on breeches piece (forward end).
b—Engine bearer (front).
d—Engine bearer (rear).
e—Drain cock on coolant covers.
g—Connection for hand turning gear.
h—Oil drain connection from Pesco oil separator.
k—Connection fire extinguisher.
l—De-icing connection.
m—Operation lever Coffman multiple breech.
p—Tachometer cable clip.
q—Pressure gage connection on breeches pipe.
r—Top cowling bracket.
t—Bottom cowling bracket.



Three-quarter front view.

Napier Sabre 2200 Hp. Engine

Typhoon Fighter Powered by this 24-Cylinder Sleeve Valve Unit

By M. W. Bourdon

Special Correspondent of AUTOMOTIVE *and* AVIATION INDUSTRIES in Great Britain

DETAILS of the Napier Sabre H-type aircraft engine were released recently by the British Ministry of Aircraft Production, only the most meager information concerning it having been published previously. Its origin is the H-type Napier Dagger engine, which the Napier Co. commenced to develop in 1935, following a decision to produce a twin-crankshaft engine of around 2000 hp. At that time the highest powered engine of any type available to aircraft constructors was in the 1000-1200 hp class and the wisdom of embarking on the development of such a high-powered engine was doubted by many people.

Although the Dagger was of the same general type and approximately the same power as the Sabre, it differed notably from the latter in that it was air-cooled, had poppet valves and its cylinders were vertical, whereas the Sabre is liquid-cooled, has sleeve valves and its cylinders are horizontal—twelve at each side of the crankcase in two rows of six, one row above the other.

The Sabre passed the official British Air Ministry 100-hr test in June, 1940, with a maximum power output of 2200 hp. But, owing to the Battle of Britain, which necessitated the makers of the Typhoon fighter (designed around the Sabre engine) concentrating for the time being on the Hawker Hurricane with its Rolls-Royce engine, it was not until May, 1941, that the first production Sabre engines were in operational service in Typhoons.

The bore and stroke of the Sabre are 5 in. and 4¾ in. respectively, giving a total piston displacement of 2240 cu in. The compression ratio is 7 to 1. The short stroke enables keeping the width of the engine down to 40 in. over-all and, in combination with the sleeve valve design and cylinder arrangement, is

largely responsible for the compactness of the power plant. The over-all length of the engine is 81.125 in. and the over-all height is 50 in.

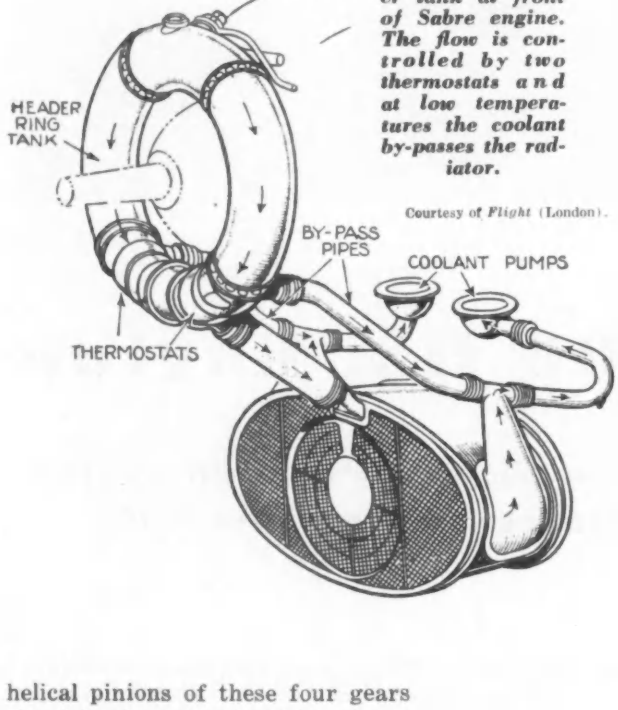
As implied above, the two crankshafts are located one above the other. The light alloy crankcase, divided vertically on the center line, comprises two units, each incorporating half of the two crankshaft main bearing groups. These two crankcase units, when bolted together, make a support for the two seven-bearing crankshafts. Bolted on each side of the crankcase is a light alloy cylinder block consisting of six upper and six lower cylinders. Each cylinder barrel has three intake and two exhaust ports of triangular shape. Shallow pistons of forged light alloy material are coupled to the crankshafts by conventional forked and plain rods, each pair on a common crank pin.

At the front end, each crankshaft is geared to a pair of compound reduction gears and from the front helical pinions of these four gears the drive is transmitted to a large diameter helical gear on the propeller shaft. This arrangement gives a double reduction of the crankshaft speed. The tubular propeller shaft is on the center line of the engine and embodies the pressure oil feed ducts for the constant-speed mechanism of the variable pitch propeller.

The single sleeve valve for each cylinder is similar to that of the Bristol engines (see AUTOMOTIVE AND AVIATION INDUSTRIES March 1 and Dec. 15, 1942), operated by a small crank and ball coupling. Double cranks arranged at 180 deg actuate the sleeves of pairs of cylinders vertically above and below one another.

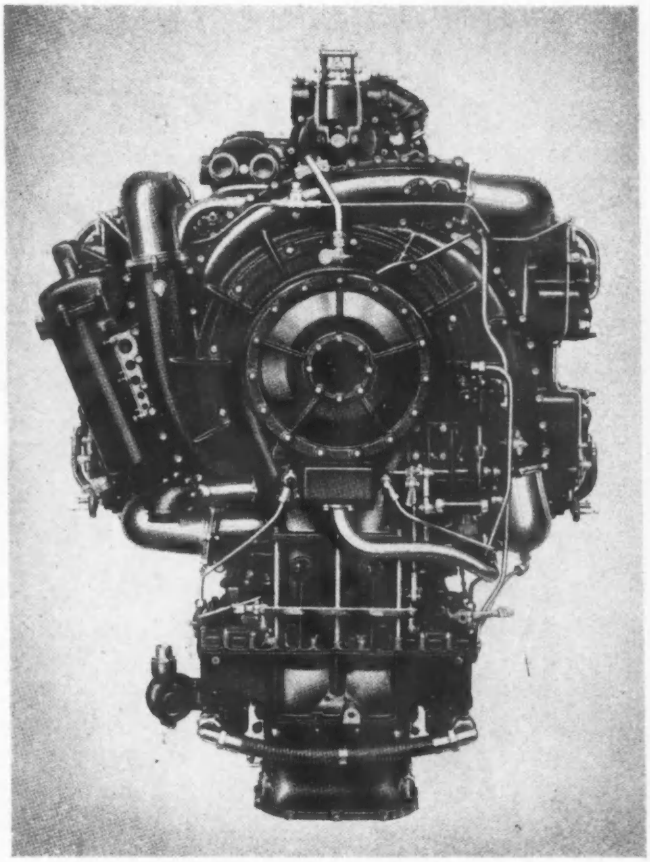
Inside the hollow worm shafts driving the sleeve cranks are torsionally flexible shafts, providing the drive for the low and high gears of the supercharger at the rear end of the crankcase. The supercharger is of the double entry type and its gear ratio is

(*Turn to page* 54, *please*)

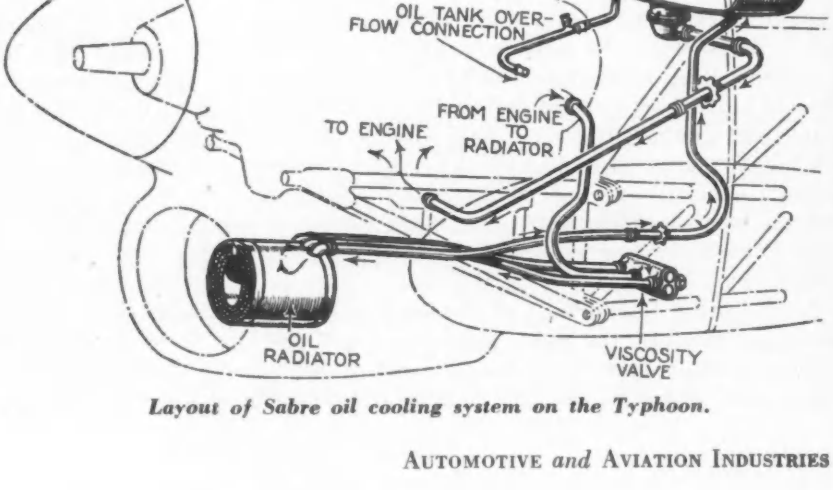


Pressure cooling system with header tank at front of Sabre engine. The flow is controlled by two thermostats and at low temperatures the coolant by-passes the radiator.

Courtesy of *Flight* (London).



Napier-Sabre engine, full rear view.



Layout of Sabre oil cooling system on the Typhoon.

Drop Hammer Dies for Short Production Runs

A PART for an airplane usually lasts in production only three months without going through design changes. To make these changes, aircraft companies such as Vultee Field Division of Consolidated Vultee Aircraft Corp. need some form of quick, inexpensive tooling for short production runs. Sheet metal forming on a drop hammer is a major part of the answer, because of the ease and comparative lack of expense involved in the making of these dies and punches.

Drop hammer dies are made at Vultee from a plaster mock-up of the part to be manufactured. The pattern is made to a "shrink scale," one-eighth of an inch oversized per foot, to compensate for the shrinkage that takes place in the die alloy. The plaster form is set on a base within a wooden frame with wooden blocks fitted at its base to provide the molding contours for the clamping ledges on the die. Damp molder's sand is sifted over the face of the pattern to insure ultra fine grain at this critical spot, and when this surface is well covered, more sand is alternately shoveled in and tamped compactly with an automatic ram.

When the sand is level with the top of the frame and thoroughly packed, a wooden top is fitted on and the entire frame and its contents are inverted. The plaster form is carefully eased out and the ledge blocks removed. A gate is formed in the sidewall for the introduction of the molten metal, and any places where the sand may have crumbled are patched with more damp sand and smoothed.

Meanwhile, the pot of Asarco die alloy (95% zinc, 2% copper, 2%

(*Turn to page* 58)

(Below) Making the sand mold from the plaster pattern preliminary to pouring the drop hammer die.

(Below) Careful pouring through a sprue spout must be done by the foundry men to prevent the gushing metal from breaking down any delicate contours of the mold. Two bucket loads, each weighing about 2000 lb., were required to fill this Convair mold.

(Below) After the metal has hardened and cooled—the big ones sometimes take 24 hours or more—die finishers grind and polish its surface to the blueprint specifications.

Plant

With paper templates cut to scale representing machines, equipment, etc., an engineer develops a new layout. Department heads concerned with a change are called in for consultation before it is approved.

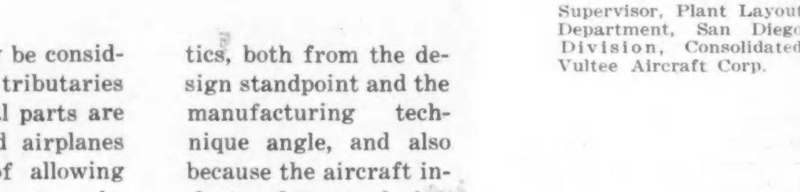
By
L. M. Olsen

Supervisor, Plant Layout Department, San Diego Division, Consolidated Vultee Aircraft Corp.

IN SOME ways a large aircraft plant may be considered as having a river with numerous tributaries running through it. Streams of metal parts are fed into the main channel until completed airplanes flow out. But unlike nature's process of allowing streams to take a winding path, engineers try to make a flow pattern of straight lines.

In developing this pattern, there are three main factors to consider: (1) Floor space; (2) Product to be manufactured; (3) Tooling and methods. The first is usually fixed; the other two are variable, more so than in most industries, and therein lies a new concept of aircraft plant layout. Instead of the static arrangements typical of most aircraft plants for many years, layouts have become somewhat transitory. This development is due to the rapid progress being made in the field of aeronautics, both from the design standpoint and the manufacturing technique angle, and also because the aircraft industry has reached a mass production status.

On a high production basis, it is economically sound to design a factory for the product and then to keep the plant adjusted as the product itself and methods



Layout changes are studied on these boards where templates cut to scale representing planes, equipment, stock racks, offices, toilets, etc., are located. When changes are made in the building, similar changes are made on the board, so that the position and location of everything in the building is represented.

Layout—Subject to Change

of making it improve. Due to unforeseen developments which occur with considerable frequency in the field of aeronautics, a carefully planned arrangement may also overnight need radical revision.

Generally, in the prewar plant, it was more economical to take the limited number of parts being manufactured to the machines, regardless of their location, than to shift equipment around to arrive at a more efficient layout. Compromises were often made because the expenses incurred in making changes could not be absorbed by the small number of aircraft manufactured. The cost of moving a large press to a new location in the same building, for example, may be $5000; the expense of moving a drop hammer may run around $16,000; and to rearrange a major fabrication department sometimes costs $50,000. Such expenditures prohibited extensive revisions in the prewar plant.

When the production drive began, aircraft companies made radical revisions in manufacturing facilities in order to meet heavy schedules. The transition from a custom-made status to a mass production basis was a pioneering era for layout engineers in the aircraft industry. For the first time in industrial history, structures weighing many tons were placed on moving assembly lines. Consolidated Vultee Aircraft Corp. constructed the first mechanized line for heavy bombers at San Diego, Calif., by placing the 28-ton Liberator B-24 bomber on a line. The 66,000 pound Coronado PB2Y-3 flying boat was also built on a powered line.

In addition to handling large structures on an assembly line basis, the problem of setting up an aircraft plant for production becomes somewhat complex due to the thousands of different detail parts manufactured and assembled. Take for example a giant bomber like the Liberator. Over 50,000 major parts go into its construction. While many of them are closely related in size and shape, there is a wide diversity among thousands of them. Approximately 20,000 of these are manufactured in the sheet metal department. Instead of following one well defined path, these parts take a variety of courses and the task of preparing flow diagrams to aid in making efficient layouts becomes somewhat involved. The nature of the parts change as design changes are introduced, and the job of adjusting nearly one million dollars worth of manufacturing equipment in the sheet metal department to fit these parts is one with which layout engineers are perpetually concerned.

Then, many design changes in the aircraft itself make layout revisions necessary to facilitate production. The Liberator B-24 has been on the assembly line now for four years and during that time over 1000 engineering changes have been made in it. These have necessitated innumerable layout changes, some of a minor nature, but many of them have involved extensive revisions.

Improved assembly methods have been the signal for making radical changes. Formerly, the forward part of the B-24 fuselage was made as one unit. This assembly contains most of the "nerve system" of the bomber, and installation of accessories inside the fuselage created a serious bottleneck. It was decided to break the section down into five panels, mount the accessories, then join the panels together. An expensive layout had to be developed to adopt this plan, but it resulted in savings over $1000 a day.

(Turn to page 50, please)

Production of wing center sections for the Liberator B-24 was speeded up when they were placed on this constantly moving line. Modifications to this line are now in progress which will further speed production.

Cylinder-Bore Wear

By Alex Taub

WHEN excessive wear occurs in cylinder bores it is usually largely due to corrosion. Such wear is more a question of "how many winters" than of "how many miles." It is a function also of the type of service the engine performs. For instance, in door-to-door operation without thermostat or crankcase ventilation it is possible to completely destroy present-day engines in a single winter, or in less than 3000 miles. On the other hand, in a test which was run by an American oil company some years ago, with six cars over 100,000 miles, the cylinder wear averaged only 0.001 in. per 140,000 miles. From the point of view of bore wear, conditions in such a test are easy, and bear little relation to normal operating conditions, whereas the type of operation referred to above (door-to-door) is severe, and also represents abnormal conditions.

No engine wears uniformly, and in the majority of engines wear in the different cylinders varies in accordance with Fig. 1. However, in some engines the intermediate cylinders wear more rapidly than those at the ends, which shows the complexity of the problem.

Were it not for corrosion, cylinder-bore wear would result in a reasonably-uniform increase in diameter over the whole range of piston-ring travel. Actually it conforms to the general pattern of Fig. 2, being a maximum opposite the piston rings when at the top of their travel, and tapering down from there over a distance of 2 to 3 in., at which point it fades into the normal wear pattern.

Quite often, where severe corrosion has taken place, a pock-marked band may be seen, as at A, Fig. 2, giving the impression that corrosion is taking place only in this area. However, a careful examination will show that the entire area designated by B has been affected, and that in area C the products of corrosion have been scrubbed off and the surface is bright. In some cases the corrosion band A extends only about half-way around the cylinder as in air-cooled engines where the front of the cylinders is over-cooled.

That the problem is a live one in the United States is indicated by the fact that the industry is being offered various correctives. Under normal conditions, satisfactory results have been obtained in the United States, but as soon as we depart from the normal, trouble starts and something must be done. A protective measure against bore corrosion is the use of short, partially austenitic, partially stainless cylinder bore inserts, which give an acid-proof surface where there is danger of the attack of corrosive elements.

At this point it is well to emphasize that where corrosion in the bore occurs, the metal is at a temperature below that at which the acid becomes active. Corrosion can be minimized by operating the engine at elevated metal temperatures, but with the severe winters and cold nights of our northern states, where cars are left out in the weather, an etching process goes on during each warm-up period. The best protection is acid proofness of the area of attack. The main factors in corrosion control may be listed as follows:

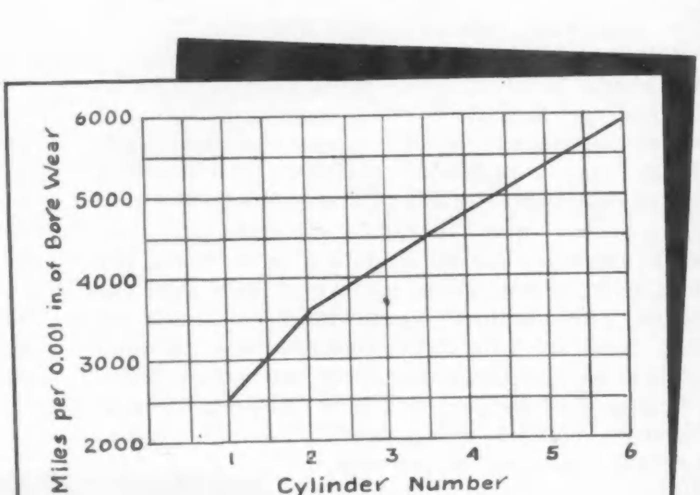


Fig. 1—Cylinder bore wear.

1. Thermostatic control of coolant-outlet temperature at not less than 145 F, 165 F being preferable.
2. Crankcase ventilation to dissipate blow-by gas and prevent contamination of the lubricant.
3. Adequate lubrication of cylinder bores, which implies a copious oil supply.
4. Complete control of lubricant at the piston rings, not at the source of supply.
5. Control of blow-by at the piston rings.

Failure of any of these control factors, or combination of them, will lead to serious trouble, and the only possible way to guard against this potential trouble in the form of bore wear is to provide an acid-proof surface. Up to date that has meant expensive liners and therefore has not been considered. Today, with the short bore insert, the picture is different.

Investigation of corrosion has been carried on under

and Corrosion

conditions of continuous cold operation. This, however, is an abnormal condition. Wear after an engine is warmed up is a more definite problem. There are many engines that are started in a warm garage and started only once every 50 to 100 miles, in which the wear is 0.001 in. per 2500 miles. And it is wear and corrosion under such conditions with which we are most concerned here.

It will be interesting to examine in detail why two engines led the American industry in respect to low bore wear during two consecutive years. They were twice as good as the average, while another engine was only half as good as the average. Thus the rates of wear of the best and the worst were as 1:4. Following are some pertinent specifications of the two engines with the best wear record:

Engine A	Engine B
Aluminum pistons	Iron pistons
L-head	Overhead valves
No water between cylinders	Water all around bores
Small bore, long stroke	Big bore, short stroke
Low axle ratio	High axle ratio
Four piston rings	Three rings
All rings pinned against turning	Rings not pinned
Bad distortion of bores	Low distortion of bores
Heavy splash lubrication	Heavy splash lubrication
Crankcase ventilator	Crankcase ventilator
Relatively lean part-throttle mixture	Relatively lean part-throttle mixture

There could hardly be two engines more unlike in design, and it is interesting to discuss the factors that placed them together at the head of their class. The tests were conducted under the vicissitudes of American weather in late summer, fall and winter, over a distance of 25,000 miles. The similarity of the lubricating systems of these two engines is significant, both having a heavy splash for the bores. Both also had highly developed oil and blow-by control, though the methods of control were different. The engine which for two years in succession showed the greatest bore wear had the shortest piston—one on which it was difficult to get good rings—and a crank-pin construction notorious for its lack of oil throw-off, due to a peculiar type of bearing. Here the bore received very little oil. This at least indicates that oil on the cylinder bore is necessary to insure a low rate of wear. Excess oil may not serve any useful purpose, but a

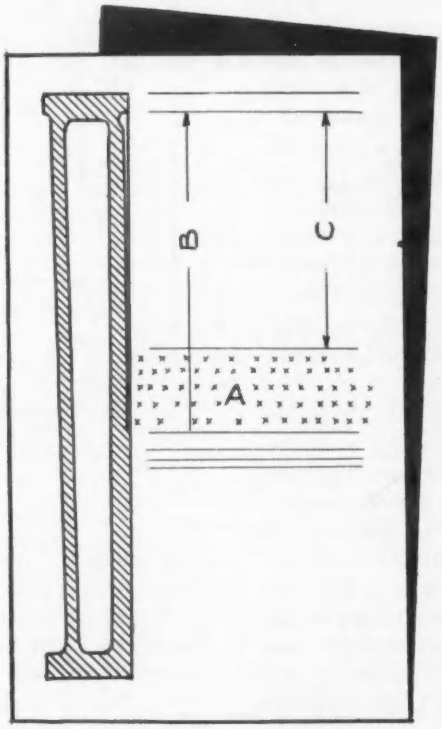


Fig. 2—Pattern of corrosion.

great deal of oil may be put on to the walls, provided that the rings, aided by the piston, will keep the oil out of the combustion chamber. That oil keeps down wear from any cause except grit is well established, but sometimes the rate of oil supply is purposely limited because it is feared that the piston rings may not give adequate control. There are grounds for this belief, and especially in Europe, where the prevalent piston-ring practice does not ensure good oil control. In this country, while great advances have been made with respect to oil control, there is need for greater piston-ring life.

A few years ago W. L. Fisher, editor of *The Automobile Engineer* of England, suggested to the author that carburation might be an important factor in bore wear and corrosion. C. G. Williams, of the Institution of Automobile Engineers, at the same time stated he suspected that the American manifold heaters might be credited with the lower rates of bore wear, as com-

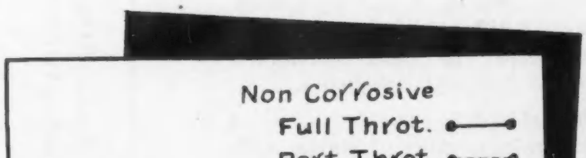


Fig. 3—Flow curves of two carburetors. Air-fuel mixture ratio versus air consumed

pared with English engines. The author at the time observed he did not believe that English carburation was quite that bad. Today it is known that 12-to-1 and 14-to-1 mixtures in the part-throttle range, may result in wear rates of 3 to 7 times normal. The words "may result" are used advisedly, as the results, though obtained with care, were from one type of engine, and other variables may have contributed to this effect. For example, the engine in question was under-oiled.

Lean mixtures favor low wear. This is rather surprising, because the oxidizing atmosphere of the lean mixture would be expected to affect bores adversely. One reason for the adverse effect of rich mixtures probably is that the oil film, already weak, is further weakened by dilution. This oil film, being too thin, is more sensitive to attack. Also, the richer mixture tends to lower the metal temperature by internal evaporation.

It must be pointed out here again that it is the part-throttle mixture that causes corrosive wear, because the internal heat of full throttle operation will raise the metal temperature above the active range of the acids formed during combustion. Fig. 3 shows the flow curves of two carburetors, one giving considerable corrosive wear, the other much less. The carburetor that was reasonably satisfactory shows a lean part-throttle mixture but a richer full-throttle mixture. The other carburetor gives substantially the same mixture for both full throttle and part throttle. Incidentally, up to 1938 this was the common type of flow characteristics of European carburetors. It needs little imagination to foresee what will happen to an engine that is operated on the choke for any length of time beyond the warm-up period, that is, on an extremely rich mixture. The starting mixture ratio is 1 to 1. The warm-up mixture ratio may be from 7 to 1 to 9 to 1.

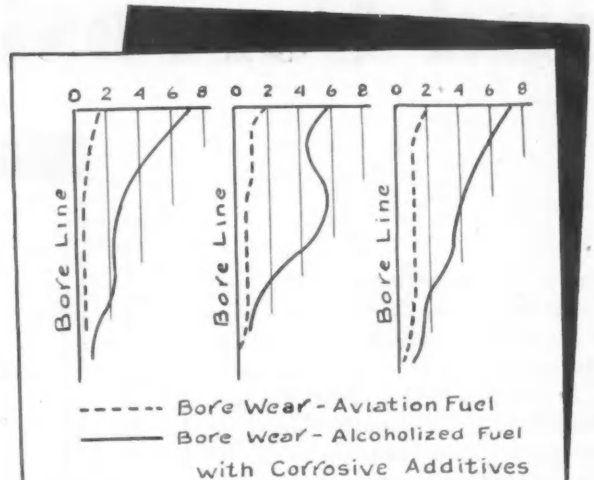


Fig. 4—Bore wear of German engine for two kinds of fuel.

Cylinder Wall Temperatures

Differences in the rates of wear in the different cylinders of an engine are undoubtedly due to differences in wall temperatures. In tests conducted under favorable conditions, including warm operation with a minimum number of starts, with alcohol and water as cooling media and thermostats set to operate at 145 F, the wear rates were as 1:3 with alcohol and water respectively. The cylinder-wall temperature was found to be 30 degrees cooler with water than with alcohol. It is interesting to note that an increase of 30 degrees in the wall temperature reduced the wear to one-third. The particular engine had its water pump in the front of the cylinder block, so that the cold water strikes the front cylinders. Modifications made in the water system changed the distribution of wear among the cylinders.

It is fair to inquire what effect the wall temperature can have after an engine has reached a stable temperature and is relatively hot. All evidence is to the effect that the acid is active at certain temperatures and relatively inactive at others, and for this reason a high and uniform wall temperature should be added to any list of factors essential to a low rate of wear. But what if the temperature-control system fails?

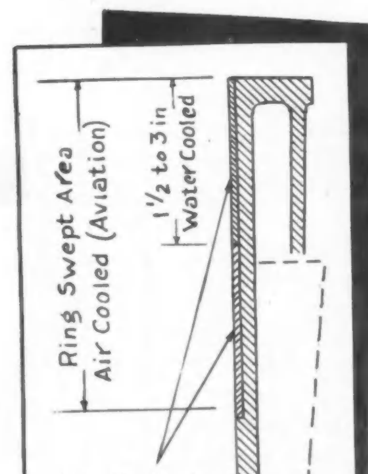


Fig. 5—Recommended length of cylinder inserts for air cooled and liquid cooled engines.

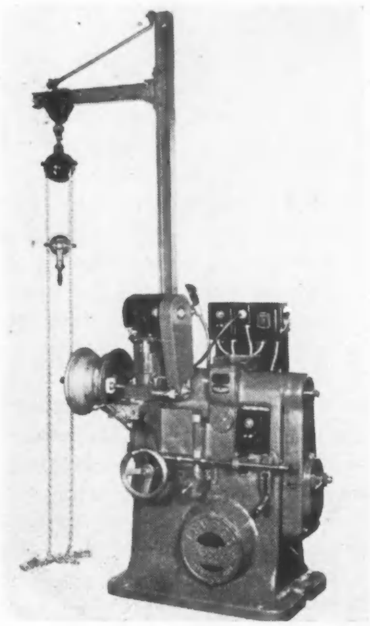
There are still many factors affecting wear, one of these being cylinder distortion. L-head engines are subject to mechanical distortion due to clamping of the cylinder head, and they may also be subject to heat distortion, due to the exhaust ports on the barrels, and sometimes to a lack of water around the barrels. One of the low-wear engines referred to in the foregoing was of this type. This engine ranks among the best for resistance to bore wear because its cylinder bores are splash lubricated and therefore receive a copious supply of oil. This would not avail if there were much blow-by. However, in this engine the piston rings are pinned to prevent rotation, so that when they are once worn in they do not have to be reseated continuously. In this engine high tension, high-point piston rings are used, with a special form cast into them. They do very well, but it would be more comforting

(*Turn to page* 60, *please*)

New Products for Aircraft

Aircraft Brake Drum Truing Machine

A special Lempco aircraft brake drum truing machine has been designed by Lempco Products, Inc., Bedford, Ohio, to meet the specific needs of military aircraft maintenance. Squirrel cage induction-type motors, magnetic starter switches, special cones to fit aircraft drums, and silencers are features of these machines. The set-up does not have to be altered to change from turning to grinding, as either the turning tool or the grinder may be brought into working position by rotating the turret.



Lempco aircraft brake drum truing machine

De-Icer System With Electronic Controls

An "electronic ice-pick" to give airplane pilots accurate and instantly variable control of their De-Icer equipment in combating every type of ice formation has been developed by the B. F. Goodrich company and the Eclipse-Pioneer division of Bendix Aviation corportion.

The new method is technically known as a "manifold solenoid De-Icer system with electronic control." Using the rubber "boots" originally developed by B. F. Goodrich and now standard winter equipment on American commercial and military planes, the system makes possible a more selective method of inflating and deflating the tubes along the wing edges so that ice broken loose by the pulsating rubber can be carried off by the slip stream.

The new device enables the pilot to vary the frequency of the pulsations to give maximum effectiveness in relation to the thickness and type of the ice being formed. Also, by means of push buttons, the pilot can cut into regular cycles and single out sections of wing or tail surfaces which require "repeat" treatment—without interrupting the system's regular automatic operating cycles.

The control board of the device looks like a juke box selector panel, and lights up to show the pilot at a glance just which De-Icer tubes are in operation. Instead of the central air pressure distributor and multiple tubing lines used hitherto, there is now a simplified plumbing system, the pressure and suction manifolds of which are located at the individual De-Icer boot connections. The manifolds are operated by solenoid-actuated distribution valves, precisely and instantly controlled by an electronic timer. The simplified plumbing has made it possible also to have up to 50 per cent greater inflation force when needed to combat extra-heavy icing conditions.

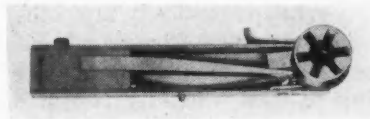
High Pressure Hydraulic Fittings

A line of high pressure hydraulic fittings is announced by the Anker-Holth Manufacturing Co., Chicago, Ill. Cut from solid steel bar stock, these fittings are constructed for 3,000 lbs hydraulic working pressure. Pipe connections are ⅜ in., and soldered connections are for ¼ in. OD by .050 in. wall seamless steel tubing. Standard high pressure assembles include: a check valve which is reversible by placing the steel ball ahead of the spring; a safety valve, which is spring loaded and adjustable; a straight connection; tee and elbow assemblies; and ⅜ in. and ½ in. 4-way operating valves.

Aircraft Hose Clamp Torque Wrench

An aircraft hose clamp torque wrench has been added to their line of torque wrenches by Richmont, Inc., Los Angeles, Cal.

Unless otherwise specified, the hose clamp model of the Livermont Torq-Stop Wrench is present to "signal" when hose clamps are tightened to a torque of 25 inch pounds, and it is claimed that they will not vary more than two per cent plus or minus. Higher or lower torque settings are available to the user's specifications.



Livermont Torq-Stop wrench

"Signaling" when the proper torque is reached, the wrench gives an audible high-pitched click and at the same time a small plunger taps the operator's hand. Both these signals eliminate the necessity for visual attention and make the operator efficient in dark or noisy areas, inside a wing, hull, or on the ramp with engines running.

Aeronca to Build New Cargo Plane

A new Army cargo plane, designated as the UC-64A, will be built by the Aeronca Aircraft Corporation. It will be the largest warplane to be built by Aeronca, with a wing span of 51½ feet, a 550-hp. engine, a ceiling of 18,000 feet, and a maximum speed of 160 miles an hour.

Production plans already have been started for the new cargo plane and the finished ship is expected to be rolled cut of Aeronca's final assembly sometime next summer. The UC-64A (utility cargo) will be the fourth Aeronca military plane, the first three being the Aeronca "Grasshopper," the PT-23AE and the PT-19BAE the latter two being training planes. The new plane will have a gross weight, including cargo, of 7,400 pounds. It will carry eight passengers—pilot and co-pilot and six others, four seated on the side and two more side-by-side in the rear. Besides the eight passengers, the plane will carry cargo up to the 7,400 pound capacity.

One of the features of the new plane is the fact that it has a landing speed of 68 miles an hour.

By James Snider
Chief Metallurgist,
Goodyear Aircraft Corp.

Merits of Salt Baths

AIR FURNACES and salt baths are both commonly used for the heat-treatment of aluminum alloys. Like practically any other piece of equipment, each type has its advantages and disadvantages. Arguments as to the merits of each have occurred from time to time whenever two or more heat-treaters got within hailing distance. Our experience has been that each type has enough advantages that the use of both is justified in the aircraft industry because of the variety of jobs to be heat-treated.

Here at Goodyear Aircraft Corp. there are salt baths that have been in operation for periods of time ranging from two months to almost four years and air furnaces which have been in production from 12 to 18 months. During this time it has been possible to get first hand information on the merits and shortcomings of these two types of furnaces. In the hope that our findings may be of some interest to the aircraft industry, this article is a brief discussion of our experiences.

All of the salt baths which are being used here for aluminum alloy heat-treatment are of the immersed electrode type, which has no doubt been partially responsible for the uniform temperatures (plus or minus 5 F) we have been able to maintain in the bath from end to end and top to bottom. The electrical field around the electrodes sets up a stirring action in addition to that caused by convection currents. Unless special precautions are taken to insure that all parts heat-treated in the salt bath are absolutely free from dirt, grease, paint, etc., a sludge which, at operating temperatures, is more viscous than the pure salt will collect in the bottom of the furnace over a period of time. This sludge is not affected by the stirring action in the bath and, as a consequence, does not maintain the same temperature as the salt above. As long as this low temperature zone remains only a few inches from the bottom there need be no cause for alarm. However, it should not be allowed to continue to build up to a depth where it would extend into the working zone. If this occurs, the bottom edges of long pieces will be annealed instead of attaining the desired heat-treatment.

The heat content of the salt is high enough that the bath temperature does not drop appreciably when the furnace is opened for charging. Because of this fact it is possible to charge simultaneously, a wide variation of gage sizes requiring different heat-treating time cycles. Since an entire load from a salt bath need not be quenched at once, it is possible to get an even flow of parts to the next operation and eliminate the need for large storage ice boxes prior to stretching, forming, etc. The rate of heat transfer from salt to the alloy is so rapid that the time of immersion can be considered the time "at heat" for the usual gages heat-treated. On the other hand, the high heat content of the salt reduces the utility of this type furnace since it is not

Fig. 1—Removing a load of aluminum alloy parts from a salt bath.

and Air Furnaces *for Heat-Treating Aluminum Alloy Parts*

Fig. 2 (Above) Part No. 1 quenched from an air furnace and part No. 2 quenched from a salt bath.

Fig. 3 (Right) A load of aluminum alloy parts being charged into an air furnace.

practical to heat-treat parts requiring different heat treating temperatures because of the time required to change the temperature of the bath.

Fig. I illustrates a load being taken from a large salt bath. Parts heat-treated in salt baths are usually suspended on small racks or handled individually if they are large enough to warrant it. This may be considered both an advantage and a disadvantage. It is an advantage because parts given more or less individual attention upon quenching can be handled in such a way that the warpage is held to a minimum. Fig. 2 shows the condition of two identical pieces—No. 1 quenched from an air furnace—No. 2 quenched from a salt bath. This method eliminates much expensive hand forming and straightening. However, it is impossible to standardize the elapsed time from furnace quench and there is danger of the operator being burned with molten salt. Because of the shape of these salt baths, the wide variety of shapes and sizes heat-treated, and the speed of quench necessary, it is very difficult to install a satisfactory mechanical handling device.

All of our air furnaces used for aluminum heat-treatment are of the circulating air types. They are being used for heat-treating sheet, plate, extrusions, and rivets. Rivet furnaces are of small cylindrical type containing a fan in the bottom. Furnaces used for heat-treating sheet, plate and extrusions are of the bottom charging type. A platform holding the load is raised into the heating chamber by a pneumatic ram. Fig. 3 shows load ready to be charged into an air furnace. It has just been rolled onto the

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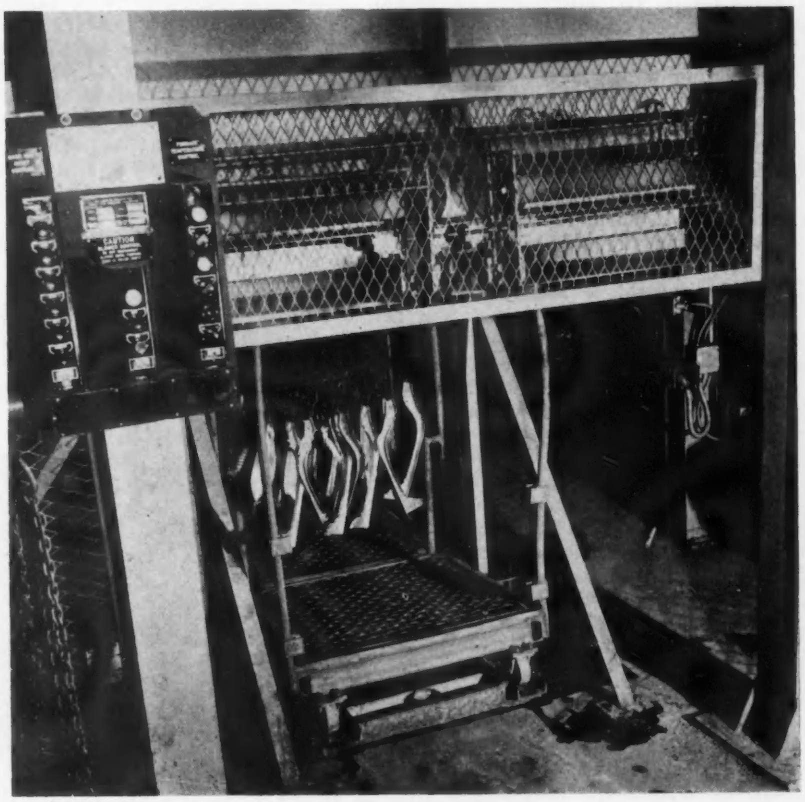
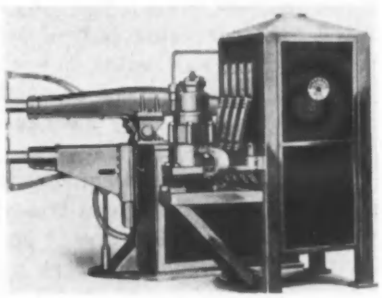


New Production

PROGRESSIVE WELDER COMPANY, Detroit, Mich., has placed on the market a direct-current welder using storage batteries as a source of welding current. The use of batteries as a source of stored energy for resistance welding involves no radical redesign of already available welding machines, since modified types of Progressive Welder machines or guns may be used in combination with the storage battery power unit.

It does make possible, however, the application of resistance welding, even in aluminum, in localities where power supply limitations have prevented the use of other forms of stored energy welders. The only requirement is sufficient power to operate a battery charger.



P. W. C. storage battery operated welder

Several types of P. W. C. resistance welders—rocker arm, pedestal and gun types—may be used in combination with the storage battery power unit. The actual welding procedure is similar to welding with conventional welders.

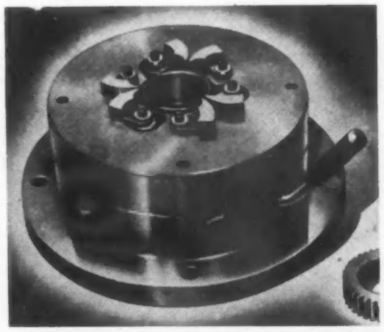
Power to keep the batteries charged is supplied from a normal "power line" —which may be either single or 3-phase a.c. The charger is of the dry-disc type rectifier, provided with automatic controls. It normally requires no attention. At the welder itself only a simple (non-synchronous) sequence welding control is needed. This, together with an automatic pressure switch on the welder and a "starting" pedal-operated switch, controls the weld cycle. Control of the actual amount of welding current is furnished by the contactor-controller.

A SPECIAL milling machine has been designed and built by the Sundstrand Machine Tool Co., Rockford, Ill., to form mill the radii and angle on the inside of propeller barrels. The part is of tough steel and requires a heavy cut on practically the entire inside edge and bottom. An angular milling cutter with a radius on the bottom, using high speed steel blades is mounted directly to the spindle which is driven by a 10-hp motor. Drive to the spindle is through V-belts with pick-off gears provided to furnish spindle speed changes in a ratio of 30 to 1. The column, in addition to carrying the vertical way surface for vertical travel of the spindle head, can be fed and traversed to and from the workpiece. The workpiece itself is held in a special fixture mounted on a 22 in. diameter rotary table. The table is of the solid spindle type with widely suspended bearings for most efficient support. The automatic cycle provides three independent motions, cross feed to the column, vertical feed to the head and rotary feed to the table, all timed and interlocked with the starting and stopping of the spindle and coolant flow.

Sundstrand hydraulic actuation is provided to each of the moving members of the machine and the rotary table is driven by a Sundstrand fluid motor. The rate of rotation can be varied infinitely from ½ in. to 10.1 in. per minute.

LEMAIRE Tool and Manufacturing Company, Dearborn, Mich., is introducing the Match-It gear chuck which is designed to give greater accuracy to holes bored or ground in gears by virtue of its unique method of gripping.

The construction of this chuck is based on the principle of the gear itself. The force holding the gear is in the same direction as that normally exerted toward the mating gears. Since pressure is always through the cross section of the tooth and not through the center of the gear, the manufacturer points out that distortion on delicate gears will not occur so easily as it will in chucking across the diameter.



Le Maire Match-It gear chuck

The chuck is designed to accommodate both helical and spur-toothed gears, either external or internal. It consists of two gripper plates—one stationary and the other movable—each having a set of grippers ground to close limits and positioned accurately. There are no cams, adjusting screws, or sliding jaws. To grip a gear, one plate carrying a set of grippers rotates toward the stationary plate causing grippers to clamp each side of tooth.

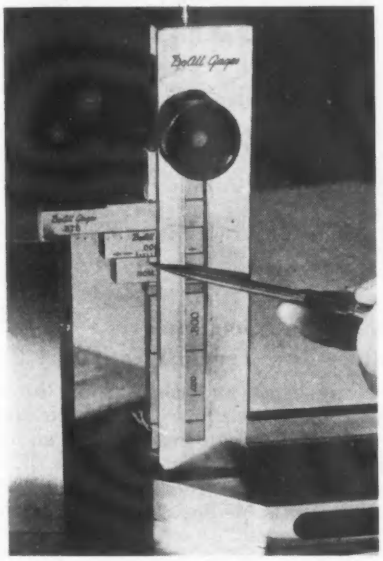
CONTINENTAL MACHINES, INC., Minneapolis, Minn., has just brought out the Doall vernier gage which extends the range of combinations of sizes which can be made with any set of gage blocks by enabling combina-

Sundstrand special milling machine

Equipment

tions to be made in steps of 10 micro inches and to the same degree of accuracy as provided by precision gage blocks.

Gage blocks in combination with the vernier gage can be set up to produce practically all types of snap gages, height gages and depth gages to millionth accuracy at a fraction of the cost of a special gage. In combination



Doall Vernier Gage

with gage blocks a precision sine bar can be set to angles within two seconds of an arc. Tool-makers and inspectors can quickly measure any dimension to within 10 micro inches. The gage is wrung together in the same manner as standard gage blocks.

The Doall vernier gage consists of two gage blocks having a precision taper on their mating faces. When the taper faces of two blocks are wrung together with their taper index marks coinciding, the blocks form a gage block whose height is .700 in. One block is graduated into 10 equal parts between the index graduations. By sliding this block to the right, the height of the vernier gage is increased ten millionths for each graduation because of the taper. Sliding the block to the left, the height of the vernier gage is decreased ten millionths of an inch for each graduation. The vernier gage has a total range of one ten-thousandth of an inch plus or minus, thereby enabling dimensions to be made in increments of ten millionths above or below any dimension which can now be made with a standard set of precision gage blocks.

THE deep gap bed of a new lathe put out by Boice-Crane Co., Toledo, Ohio, gives 50 per cent more face plate turning capacity than the straight bed type. This new machine has 60 in. center, 11 in. swing over bed and 17 in. by 3 in. over gap.

A heavy cast iron head base and tailstock are provided. The large spindle and high grade ball bearings are said to permit heavy turning with extreme accuracy.

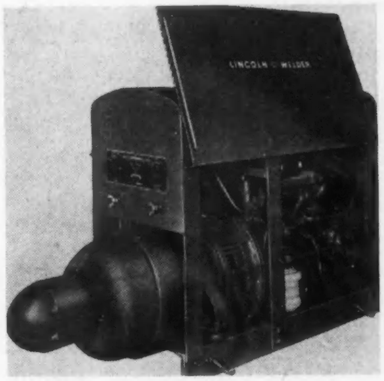
An improved indexing device permits layout of circular work into a number of equal divisions. The tailstock spindle is calibrated for boring operations of accurate depth.

Proper speeds for woodturning and metal spinning are permitted by the 4-step cone pulley. All boring, reaming, and milling operations are performed in a master jig.

The live spindle has a hole clear through, for chucking long rods or dowels. Both spindles have No. 2 Morse taper sockets, and tailstock has a self-ejecting center feature.

A "SHIELD-ARC" engine-driven welder rated at 200 amperes of light weight, rugged construction with an enclosed, rubber mounted engine of 29 hp, is announced by The Lincoln Electric Company, Cleveland, Ohio. This new unit, supplied complete with base and canopy has a current range of 40 to 250 amperes. Dual control of welding current is accomplished by adjustment of series fields and generator speed.

The generator control or "job selector" assures accuracy of open circuit voltage and permits precise control of engine speed of from 1150 to 1500 rpm for welding. In addition, this control may be used to manually reduce the engine speed to as low as 750 rpm whenever it is necessary to stop welding at intervals of a few minutes.



Lincoln "Shield-Arc" engine-driven welder

With this new unit an engine speed of from 1150 to 1400 rpm is used for the majority of welding applications. The generator can produce its rated current of 200 amperes when the "job selector" is set so that the machine operates at speeds as low as 1200 rpm.

Weight of the unit as illustrated is approximately 1130 lbs. Over-all length, 65¼ in.; width, 24 in. and height, 41½ in.

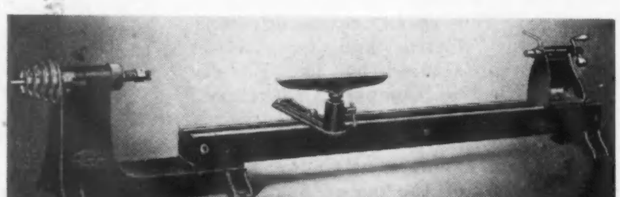
A NEW helium-shielded arc-welding electrode holder for manual operation is offered by the General Electric Company, Schenectady, N. Y. The new holder, which may be used with either helium or argon gas, is specially designed for use in the welding of light metals, such as magnesium and its alloys, where precise heat control and protection from the oxidizing effect of the air are required. It can also be used in the welding of other hard-to-weld metals, such as aluminum and stainless steel.

The holder is light and consists of a Textolite handle, a steel gas nozzle, and a copper electrode clamp fitted with a tool steel spring-collet. A fixed angle of 76 degrees between the nozzle and the handle contributes to the balance and "feel" of the holder. The electrode clamp is constructed to hold a tungsten or a carbon electrode until all but a ¾-in. stub is consumed. The handle, gas nozzle, and electrode clamp are fully insulated.

A button for controlling the gas sup-

(*Turn to page 60, please*)

Boice-Crane lathe

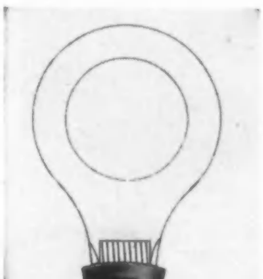


New Products

Pre-Insulated Terminals

Aircraft-Marine Products, Inc., Harrisburg, Pa., has brought out a pre-insulated terminal with the insulation permanently bonded to the copper of the terminal so that it cannot be accidentally removed.

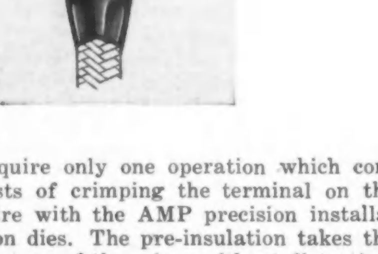
Pre-insulation eliminates the need for applying insulating sleeving to crimped terminals. These terminals



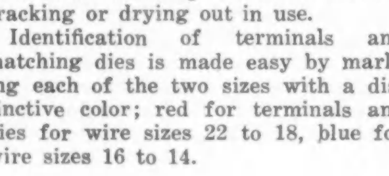
Aircraft-Marine Products pre-insulated terminal

require only one operation which consists of crimping the terminal on the wire with the AMP precision installation dies. The pre-insulation takes the contour of the crimp without distortion, cracking or drying out in use.

Identification of terminals and matching dies is made easy by marking each of the two sizes with a distinctive color; red for terminals and dies for wire sizes 22 to 18, blue for wire sizes 16 to 14.



Topflight broken drill adapter



Topflight flute key collet

Silver Streak metal marker

Small Hand-Operated Marking Device

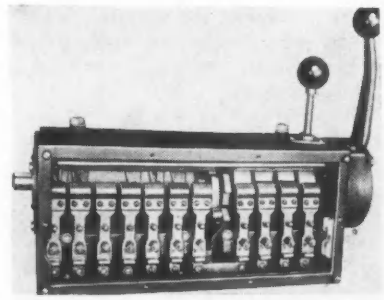
A small hand-operated marking device, known as the Silver Streak Metal Marker and marketed by the Topflight Tool Co., Towson, Md., permits placing identifying marks on metal tubes, bars and flat stock. The Topflight set includes two markers, one to accommodate small type for tubing, the other to hold large type for flat pieces. A quantity of alphabet characters and numerals of various sizes are included with the equipment. Porous inking wheels carry a quick drying ink which comes in several different colors, including a silver ink which is said to provide the greatest contrast on all types of metals. A grooved wheel is provided to guide the device when marking tubing.

Tools to Utilize Broken Drills

Two tools, designed to utilize broken drills, have been placed on the market by the Topflight Tool Co., Towson, Md. One is a collet which can be used to reach otherwise inaccessible places with an angle drill; the other is an adapter which can be used as an extension as well as a broken drill holder. Both tools have a flute-locking device which makes it possible to clamp and use small pieces of broken drills. Vibration in operation increases the locking grip, according to the manufacturer.

Simplified Four-Speed Reversing Controller

Improved economy in current consumption is a feature of the new M-79 simplified four-speed reversing controller for electric and gas-electric trucks manufactured by The Elwell-Parker Electric Company, Cleveland, Ohio. The new controller uses resistance on the first speed only. An additional power saving is attributed to the manipulation of the motor fields, connecting them in series on first and second speeds, which produces greater torque with less current consumption. The welded housing of the new controller is dust tight and meets all specifications for flash-proofing. The M-79



Elwell-Parker M-79 controller

controller is installed on all Elwell-Parker Electric or Gas-Electric low and high lift trucks in capacities up to 10,000 lbs.

Goodrich Speedliner Silvertown Truck Tire

New design and construction of the Speedliner Silvertown truck tire make it run cooler than ever before, according to an announcement by the B. F. Goodrich Co., Akron, Ohio. The new tire is available in size 7.50-20 eight-ply or larger.

Reduced tread thickness at the shoulders, addition of new ventilating grooves in the shoulder blocks, are principal changes in the tire construction which lessen operating heat, while other improvements in design reduce dangers of sidewall cracking. The sidewall has been made thicker at the base of the grooves between the shoulder blocks, and the ornamental rib on the sidewall constructed shallower to provide better distribution of stresses.

Speedliner Silvertown truck tire

NEWS OF THE INDUSTRY

UAW-CIO Loses in NLRB Polls at Some of Largest Aircraft Plants

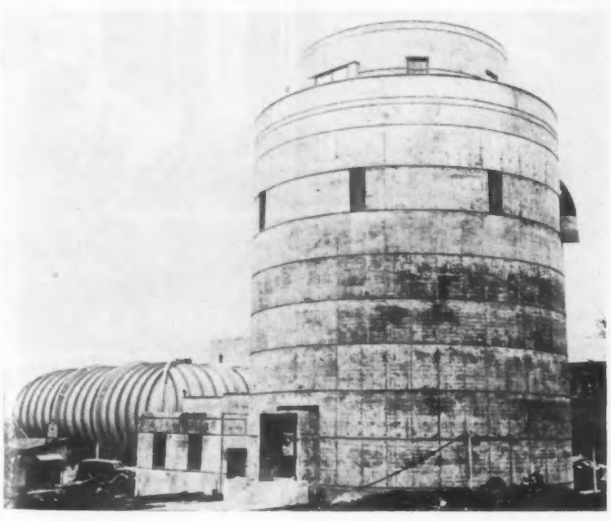
Wins in a Number of Other Plants. Large Reduction of Labor Turnover Increases Output on West Coast

Efforts at further penetration into the aircraft industry have resulted in two setbacks for the UAW-CIO at plants on the Atlantic and Pacific coasts, although the union did win NLRB polls at Douglas Aircraft Co., Inc., plants in Chicago, Southgate and Long Beach, Cal. In the huge Douglas parent plant at Santa Monica, Cal., 53.3 per cent of the employes voted for no union in a runoff election against 46.7 per cent for the UAW-CIO. In the first election, in which 91 per cent of the 21,000 employes voted, 39.7 per cent favored no union, 34.3 per cent preferred the UAW-CIO and 26 per cent the International Association of Machinists (AFL). At Douglas' Long Beach plant, 84.2 per cent of the 27,356 eligible workers cast ballots in an NLRB election. Forty-six and one-half per cent, or 10,699, favored the UAW-CIO, 33.6 per cent (7,725) voted for no union and 19.6 per cent (4,590) cast ballots for the AFL Machinists' union. In the ensuing runoff election between the two unions, the UAW-CIO received 58.3 per cent of the votes and the IAM had 41.7 per cent. The UAW-CIO also won an NLRB election at the new Douglas plant in Park Ridge, Ill., near Chicago, getting 4,336 votes, or 80 per cent, compared to 1,089 for the Machinists' union. In a former GM assembly plant now operated by Douglas at Southgate, Cal., the UAW-CIO received 59 per cent to 40 per cent for no union.

However, in an election at the Republic Aviation Corp., Farmingdale, N. Y., 58.9 per cent voted for no union and 32.4 per cent favored the UAW-CIO. A recent group incentive bonus system was an issue in the Republic election, the company charging that the union was trying both to discredit the amount of the bonus and to take credit for having it adopted in its pre-election campaign to win bargaining rights at the plant. The bonus system at Republic, approved in December by the WLB, is based on a standard of plant efficiency in terms of the number of man-hours per P-47 fighter plane that is considered a good production job. Each month the total number of planes produced, including spares, is multiplied by the standard man-hours per plane to set up a yardstick. This is then divided by the total man-hours of labor paid for during the month. The result is the plant's efficiency for that month. For every per cent of increase in efficiency above 85 per cent, the company pays a bonus of 1 per cent on the total take-home earnings of all employes, except officers of the company. An incentive bonus of 13.5 per cent was paid in November and of 19.4 per cent in December to Republic employes. Results of the incentive system were reflected in the company's December record, when more fighter planes were produced than ever before had been made by a U. S. company in a single month.

(*Turn to page* 84, *please*)

Vertical Wind Tunnel



The AAF Materiel Command's new vertical wind tunnels nears completion at Wright Field, Ohio. Parachutes and three-foot models of planes will be tested in the tunnel. Floating in a 70 to 135-mile-per-hour air stream, the planes will be dived, brought out of spins, and put through other maneuvers by means of their controls, which in turn will be regulated by the action of magnetic rings around the test chamber.

AAPM Elects Officers

Clarence C. Carlton, vice-president of Motor Wheel Corp., has been elected to his tenth consecutive term as president of Automotive & Aviation Parts Manufacturers, Inc. Change of the association's name from Automotive Parts & Equipment Manufacturers, Inc., in recognition of the increasing participation of the member companies in the aircraft parts field, was formally ratified at the recent annual meeting in Detroit.

Raymond B. Collins, who has a background in aviation dating back to World War I, has been appointed manager of the association's newly formed Aviation Division, according to Frank Rising, general manager. Collins recently has served as civilian chief of the priorities and statistical control sections of the Central Procurement District, Army Air Forces, in Detroit. For nine years Collins was general manager and referee of the National Air Tours for the Edsel B. Ford Trophy. He also was director of the Michigan Board of Aeronautics for three years and manager of the aviation dept. of the Union Trust Co., Detroit.

Other officers elected for 1944 were Frederick C. Crawford, president of Thompson Products, Inc., vice-president, and James L. Myers, executive vice-president of Cleveland Graphite Bronze Co., secretary-treasurer. Directors elected to new terms were: Three years—M. P. Ferguson, Bendix Aviation Corp.; Arden LeFevre, Stewart-Warner Corp.; C. I. Ochs, Eaton Mfg. Co.; W. D. Robinson, Briggs Mfg. Co., and G. A. Shallberg, Borg-Warner Corp. Two years—A. G. Drefs, McQuay-Norris Mfg. Co.; H. H. C. Weed, Carter Carburetor Co., and W. C. Williams, General Motors Corp.

Parts Industry Important Factor in War Production

Automotive Industry Producing War Materials at 4½ Times 1942 Rate. Navy Eliminates Glider Program

In the two years since civilian automobile production came to a halt by order of the WPB, Feb. 10, 1942, the automotive industry has delivered $14,200,000,000 worth of war materials, according to the Automotive Council for War Production. The industry has boosted its annual rate of war production from $2,300,000,000 in 1942 to upwards of $10,500,000,000 today. Reports from 1038 of the industry's principal plants show that aircraft is the No. 1 product with deliveries of $5,030,000,000 in the two-year period. Military vehicles and parts rank second with shipments of $4,200,000,000. while tank production is third with deliveries of $4,200,000,000. Other armament totals are: guns and parts, $1,150,000,000; marine equipment, $1,020,000,000; ammunition, $500,000,000 and miscellaneous products, $400,000,000.

The automotive parts industry, whose figures are included in the above total for the entire automotive industry, is producing munitions at an annual rate of more than $3,000,000,000. A survey of the 392 member plants of the Automotive & Aviation Parts Manufacturers, Inc. (formerly APEM) reveals that 29.3 per cent of the parts companies' output is in the aircraft classification, 21.3 per cent military vehicles and parts, 15.8 per cent tanks and parts, 13.7 per cent ammunition, 3.6 per cent small arms and artillery, 3.4 per cent marine equipment, 4.7 per cent replacement parts for civilian cars and trucks and the remainder miscellaneous.

Official figures on U. S. truck production since Pearl Harbor, just released by the WPB, show that 797,195 trucks were manufactured in 1942 and 500,845 trucks were built in the first nine months of 1943. WPB stopped the production of civilian light trucks Feb. 10, 1942, that of medium trucks April 30, 1942, and heavy trucks May 31, 1942. Production of approximately 10,500 heavy trucks for civilian use later was authorized by WPB but less than 3000 of these had been built up to the end of 1943. Therefore, practically all the 500,845 trucks built in the first nine months of 1943 were for military or lend-lease purposes, the total including jeeps and ambulances but no track vehicles or armored cars. The War Dept. had requested the production of 671,107 trucks in 1943 for U. S. military and lend-lease needs, of which it was estimated in mid-December that 607,610 would be delivered, according to the Truman Committee report on transportation.

The War Dept. truck program for 1944 was reported as calling for 742,433 vehicles, but some recent revisions have been made in this program. The WPB truck advisory committee met in late January to consider possible cutbacks in the military truck program and the possibility of diverting material, facilities and manpower into production of essential civilian trucks. Some military cutbacks already have been made at Dodge and Ford. Output of half-track combat vehicles, armored cars and universal carriers also has been curtailed or cancelled at several plants. Production of military vehicles at other plants has been held up by a shortage of transmission and transfer cases, caused in turn by the tight situation in bearings. White Motor Co. at Cleveland has had its contract for half-track combat vehicles cancelled, while Autocar's contract for half-track units has been cut back.

The increasing emphasis on airplane production in 1944 is evident in the naval aircraft procurement program as well as that for the Army Air Forces. Reflecting a heavy expansion in fighter and bomber output, the Navy's schedules call for $4 billion in aircraft this year compared with $2½ billion in 1943. Naval aircraft cutbacks have totaled $226,000,000, comprising trainers, transports, airships, outmoded patrol bombers and scout observation planes. This will make way for more advanced planes as well as elimination of the glider program, gliders having proved unsatisfactory for naval use. Two and one-half times as many Navy planes were built in 1943 as in 1942 and they comprised 75 per cent combat types.

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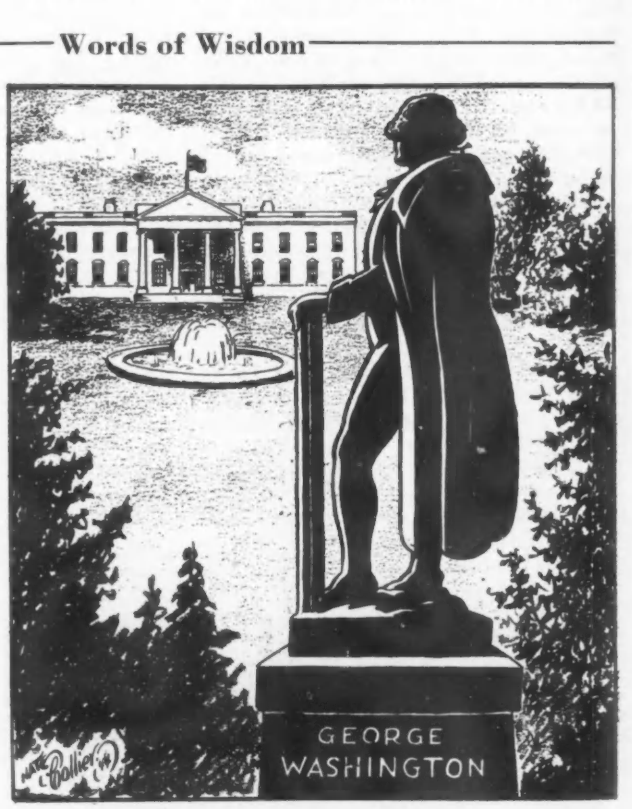
238,720 Rationed Cars Were Sold During 1943

A tabulation by States of the number of rationed passenger automobiles (all new automobiles and used 1942 cars) sold during each of the twelve months of 1943 was released recently by the Office of Price Administration.

The tabulation shows that a total of 238,720 cars were sold to eligible civilian users during last year. The largest number of cars—31,248—was released during the month of April. This peak tapered off to 11,314 cars sold in December. The all-year low was in January, when 10,570 were sold.

Words of Wisdom



. . . The disorders and miseries which result, gradually incline the minds of men to seek security and repose in the absolute power of an individual; and sooner or later the chief of some prevailing faction, more able or more fortunate than his competitors, turns this disposition to the purposes of his own elevation on the ruins of public liberty . . . the common and continual mischiefs of party are sufficient to make it the interest and duty of a wise people to discourage and restrain it.

It is important that the habits of thinking in a free country should inspire caution, in those intrusted with its administration, to confine themselves within their respective constitutional spheres, avoiding in the exercise of the powers of one department to encroach upon another. The spirit of encroachment tends to consolidate the powers of all the departments in one, and thus to create, whatever the form of government, a real despotism. A just estimate of that love of power, and proneness to abuse it, which predominate in the human heart, is sufficient to satisfy us of the truth of this position . . .

But let there be no change (constitutional powers) by usurpation; for though this, in one instance, may be the instrument of good, it is the customary weapon by which free governments are destroyed.

—*George Washington in his Farewell Address*

Producers of Sheet Aluminum Advised to Step Up Output

Surplus in Aluminum Pig Production Not Reflected in the Sheet Metal. Demand Expected to Increase

By W. C. Hirsch

In both ferrous and non-ferrous metals the closer fit of finishing capacity with demand than is true of primary facilities is the cause of periodically recurring apprehension on the part of procurement officials for the armed forces. So the heightened tempo of the fighting in Italy caused flat rolled steel schedules to be subjected to renewed scrutiny. Cutbacks in the drum program and minor adjustments elsewhere appear to have eased the pressure adequately. Aluminum sheet producers were advised by the War Production Board that their output must be stepped up immediately if 1944 aircraft programs are to be met.

It appears that retrenchment in the output of primary aluminum, made possible by record-breaking production in recent months, has been misunderstood by some and it was feared that, if this were permitted to continue, the aviation program might suffer. So Philip D. Wilson, director of the WPB aluminum and magnesium division, issued a statement to the effect that, while there was a surplus in the current aluminum pig production, there was none in sheets and that the probabilities were that toward the end of the year aircraft needs would be much heavier. It is significant that Mr. Wilson made it a point to appeal to the workers in aluminum rolling mills to stick to their jobs, so as not to imperil the aircraft program. According to Mr. Wilson's statement, inventories in the hands of aluminum rolling mills are the equivalent of 15 days' supply. Obviously some aluminum rolling mill operatives saw in recent reports of curtailment in the output of primary aluminum an alibi for absence from work. It is unlikely that any executive read into the reports of top-heavy output of pig and ingot aluminum that there was a surplus of sheet aluminum. It may also be pointed out that until the outbreak of the war and the rise of the aviation industry's importance, rolled aluminum products hardly compared in importance with castings. And so to the layman, reports of top-heavy aluminum production did not convey that they did not pertain to aluminum sheets.

WPB recently announced revocation of its order L-106, which restricted the use of copper in many automotive parts. Present and anticipated supplies of copper and copper base alloys are now considered sufficiently favorable to permit their use in the production for civilian use of automobile radiators, gaskets, fuel and oil lines, brake and clutch lining rivets and other essential parts. It is estimated that this order will result in 5,000,000 pounds per quarter being made available for use in automotive parts. Users of anti-friction bearings have been ordered by WPB not to accept deliveries in excess of specified amounts during any one month of the second or third calendar quarters of 1944 without specific WPB approval.

Plastic Tooling Society Organized

Plastic tooling, one of the least publicized aids in volume production of warplanes but recognized as one of the nation's most ingenious war-born developments adaptable to postwar industrial planning, was given added impetus with the formation of the National Society of Plastic Tooling by representatives of five major aircraft firms in the eastern United States.

The new organization, holding its charter membership open for invited west coast and other industrial area participation, held its organizational meeting early this month at the Hotel Vanderbilt, New York. Delmar Anderson, Superintendent of Production Planning and Tool Design for the Buffalo (N. Y.) warplane plants of Curtiss-Wright Corporation, was elected president of the new Society. Besides Curtiss-Wright, the four other major aircraft companies participating, were: Bell Aircraft Corporation, Consolidated-Vultee Aircraft Corporation, Grumman Aircraft Engineering Corporation and The Glenn L. Martin Company.

Tanks Land in Marshalls

U. S. tanks on the beach at Enubuj Island, part of the Kwajalein Atoll in the Marshalls. Note the stacks on the rear of the tanks, which prevent the entrance of water into the exhaust pipes.

Business in Brief

***Written by the Guaranty Trust Co., New York, Exclusively for* Automotive and Aviation Industries**

Average levels of general business activity have maintained an upward trend. The seasonally adjusted index of *The New York Times* for the week ended February 5 stood at 148.8, as against 150.3, a new all-time peak, in the preceding week and 136.4 a year ago.

Department store sales during the week ended February 5, as reported by the Federal Reserve Board, declined from 139 to 138 per cent of the 1935-39 average. Total values recorded were 2 per cent above the corresponding figure in 1943, and sales for the four weeks then ended were 7 per cent above the total a year earlier.

Railway freight loadings during the week ended February 5 totaled 806,075 cars, 0.6 per cent less than the preceding weekly figure but 6.7 per cent above the comparable number in 1943.

Production of electric power during the same period registered an advance, contrary to the usual seasonal trend; and the total was 14.2 per cent above the output a year ago, as against a similar excess of 13.8 per cent recorded a week earlier.

Crude oil production in the week ended February 5 averaged 4,400,150 barrels daily, 9300 barrels below the figure for the week before and 18,650 barrels less than the average recommended by the Petroleum Administration for War.

Production of soft coal during the week ended January 29 was estimated at 12,830,000 net tons, 1.4 per cent above the preceding weekly figure and 11.6 per cent greater than the output a year earlier.

Engineering construction contracts awarded during the week ended February 10 totaled \$23,151,000, as against \$35,523,000 a week earlier, according to *Engineering News-Record.* Contracts so far reported in 1944 show a decline of 43 per cent from the comparable amount in 1943.

The Irving Fisher index of wholesale commodity prices for the week ended February 11 was 112.5 per cent of the 1926 average, one fractional point above the preceding weekly figure, as compared with 110.7 a year ago.

Member bank reserves declined \$365,000,000 during the week ended February 9, but excess reserves rose \$10,000,000 to an estimated total of \$1,550,000,000. Business loans of reporting members declined \$3,000,000 in the same period but stood \$262,000,000 above the total a year earlier.

PERSONALS

The appointment of **William O. Wilson** as a commercial vice-president of Worthing Pump and Machinery Corp. has been announced. His new duties include general supervision and direction of all of the company's commercial activities in the Chicago, St. Louis, Kansas City and St. Paul district office territories.

McCulloch Engineering Corp. has announced the appointment of **Donald A. Sutherland** as field engineer in charge of sales and sales promotion activities. Mr. Sutherland, before coming to McCulloch, was with Fairbanks-Morse.

Appointment of **H. H. Barnes** as director of the Proving Ground Section of General Motors at Milford, Mich., has been announced.

Interstate Aircraft has announced the appointment of **F. L. Holser** as manager of the DeKalb division. This is in addition to his duties as vice-president of the company. The appointments of **W. E. Arrain** as production manager and **H. P. Rasp** as factory superintendent of the DeKalb plant, have also been made.

Lewis W. Stafford has been appointed district manager for the Toledo Steel Products Co. for the state of Michigan. For the past two years he has worked for the War Dept., Cleveland Ordnance District, in the automotive branch.

W. P. Seiberling has been named secretary and **H. E. Thomas** assistant treasurer of Seiberling Rubber Co.

The Sales Dept. of Wolverine Tube Div. of Calumet and Hecla Consolidated Copper Co. has announced the appointment of **G. H. Tobelman** as manager of the Eastern Territory, with offices in New York City.

Raymond C. Franklin has joined the sales force of the Continental Screw Co. He was formerly with the Corbin Screw Div. and National Screw & Mfg. Co.

The promotion of **J. H. Clark**, general manager of sales for the Plastic Div. of Monsanto Chemical Co., to the position of sales director has been announced. **F. A. Abbiati** succeeds Clark as general manager; **J. R. Turnbull** has been appointed assistant general manager of sales in charge of sheet materials and **S. L. King** has been made sales manager of the vinyl resins dept.

Chrysler Corp. has announced that **Clyde L. Reece** has joined the public relations staff of the company.

Roger C. Bascom has joined the technical service staff of Hycar Chemical Co. and will serve New England, Eastern New York State and Northern New Jersey.

(*Turn to page* 70, *please*)

Obituary

George R. Bury, 58, one-time general sales manager of Packard Motor Car Co., died Feb. 10 at his home in Hollywood, Cal. He was associated with Packard after World War I.

Harry N. Omer, 43, assistant sales manager of Great Lakes Steel Corp., died Feb. 3 in Detroit after a long illness.

Alva L. Grinnell, Detroit Office district manager of the Rustless Iron and Steel Corp., died Feb. 3 at Detroit.

Frazer Buys Warren City Tank & Boiler Co.

Joseph W. Frazer, who resigned last September as president of Willys-Overland Motors, Inc., has purchased the Warren City Tank and Boiler Co. at Warren, Ohio, for an undisclosed sum. The Warren company, a subsidiary of Taylor Winfield Corp., manufactures landing barges and other war material in a $9,000,000 plant built in 1942. Machinery and equipment are valued at $1,000,000.

Parts Industry Important Factor in War Production

(*Continued from page* 46)

Fisher Body's participation in the manufacture of the new B-29 "Superfortress" was disclosed recently by E. F. Fisher, general manager of that General Motors Division. Fisher Body is making major assemblies and parts required by the three assembly plants currently engaged in production of the Boeing-designed super-bomber. Eight Fisher Body plants in Michigan and Ohio are working on this program. The huge Cleveland Fisher Aircraft plant, originally built for final assembly of the B-29, has been converted for the manufacture of a new GM-designed fighter plane, the P-75. Fisher Body also is contributing to two other important plane programs, making major assemblies and parts for the B-25 bomber and parts for the B-17 bomber. In addition, the Ternstedt Division is making precision aircraft instruments.

Buick Motor Division of GM, which already has manufactured more than 35,000 Pratt & Whitney 14-cyl., 1200-hp engines for installation in B-24 bombers, is retooling some of its machines to produce another version of the same Twin Wasp engine used to power military cargo planes. The cargo plane engine manufacture will be carried on simultaneously with that of bomber engines. About 50 per cent of the fabrication will take place at Buick's Flint plants, with final assembly at the new Melrose Park, Ill., plant.

Delco Radio Division of GM has taken over four buildings of the Vigo Ordnance Plant at Terre Haute, Ind., for assembly of radio and electronic equipment. Employment will total 500 persons. Meanwhile, other ordnance plants have suffered cutbacks. Evansville Ordnance plant at Chrysler Corp. has laid off nearly 6000 employes in the last three months, a decrease of more than 50 per cent in personnel, due to scaling down of schedules on .45 and .30 caliber ammunition. The Des Moines (Ia.) Ordnance plant, operated by U. S. Rubber Co., is laying off 5000 employes in February and March in addition to 4000 dismissed in the previous three months. The plant manufactures .30 and .50 caliber cartridges, of which the Army has a surplus. The Weldon Spring Ordnance Works at St. Louis, operated by Atlas Powder Co., also has closed down, letting out 2500 workers.

PUBLICATIONS

A bulletin issued by General Electric Co.'s Tube Div. contains a new quick-selection chart of **electronic tubes** for industry. It is bulletin ET-12.*

A new booklet entitled **Operating Information on Stellite 98M2 Cobalt-Chromium-Tungsten Turning and Boring Tools and Milling Cutters** has been issued by Haynes Stellite Co. It is designed to help users obtain the best possible results with 98M2, the cast cobalt-base alloy which was developed especially for faster machining of steel.*

A new pocket-size catalog has been issued by the Onsrud Machine Works, Inc., presenting every machine and tool manufactured by the company. It is designed to give a complete picture of the equipment offered in an easily readable and understandable form. Included are both **nonferrous metal and woodworking machines, tools and cutters.**

Cincinnati Milling and Grinding Machines, Inc., has issued the third edition of its Catalog No. M-995-2, listing latest machines for **milling, broaching, grinding, lapping and cutter sharpening.** It is recommended for the desk of engineers, master mechanics, production executives and purchasing agents.*

A new **valve Selection Chart** has been announced by the Reading-Pratt & Cady Div. of American Chain & Cable Co., Inc. It is designed for shop training, or for a refresher on valves.*

Pioneer Pump & Mfg. Co. has issued a new **Pump Engineering Manual.** It is designed as a reference book for machine tool builders and pump users. It tells how to determine the size of pumps, how to make proper pump installations and has charts that enable pump users to determine pump capacity requirements. Requests must be on company letterheads.*

Aircraft Engine Lubrication is the title of a 44-page booklet published by Sinclair Refining Co. It contains a new altitude engine performance chart revealing problems of pressure, temperature and power loss that must be solved in flight operation; also full color charts of lubrication systems of leading aircraft engines; a chart showing the crude oil producing fields; a table presenting the natural characteristics of the various crude oils and their adaptability to production of lubricating oils.*

Square D Co. has issued a 36-page bulletin on **Saflex Plug-in Duct, Saflex Feeder Duck, Square-Duct and Screw Cover Duct** for electrical distribution systems. It includes a complete description and application data, price information and illustrations.*

Abrasive milling is the topic of a new Horizontal catalog just issued by the Andrew C. Campbell Div., American Chain & Cable Co., Inc. A special chart on the back page outlines the standard models in the Campbell Abrasive Cutting line—tells what it cuts, how it cuts and the features.*

The A. F. Holden Co. has issued a new booklet on **Holden Neutral Baths** for hardening and tempering. It is Bulletin 110.*

A 4-page stock tool bulletin covering its revised line of **single-point, diamond-ground carbide tools** has been released by Tungsten Carbide Tool Co. Complete specifications and prices of all tools are listed.*

The **research background of sulfurized cutting oils,** including the history of their development and improvement, and **technical data regarding their use,** such as cutting speeds, tool angles, and tool life in connection with various metals, are presented in the February issue of **Lubrication,** published by The Texas Co.

* Obtainable by subscribers within the United States through Editorial Dept. AUTOMOTIVE *and* AVIATION INDUSTRIES. In making requests for any of these publications, be sure to give date of the issue in which the announcement appeared, your name and address, company connection and title.

For Flight Tests While a Plane Rests

Another Way HydrOILics Serve Aviation

"Earthbound flight tests" are contributing more and more to the safety of globe-circling planes like the Clipper of Pan American World Airways, above.

On landing fields, at piers, and in hangars, HydrOILic Test Stands check the flight performance of all types of aircraft. Four of these testing units are shown at left.

The one at the top tests aircraft magnetos under various conditions encountered in actual flight.

Performance of all hydraulically operated parts is checked by either of the two center units. One is powered by a gasoline engine; the other by an electric motor. Both furnish 3000-pound test pressures.

The lower unit tests aircraft spark plugs against electrical leakage. Other HydrOILic Test Stands not shown here check still other phases of aircraft performance.

Tests like these are only *one* of the roles HydrOILics play in today's aviation. Other types of HydrOILic Equipment are used in the manufacture of planes and parts, or in the ships themselves.

If you need hydraulic equipment, or if you'd like information on adaptations of oil-hydraulic power and its control to your requirements, we suggest you get in touch with HydrOILic Engineers. They may already have your answer! The DENISON Engineering Company, 1178 Dublin Rd., Columbus 16, Ohio.

HydrOILics
INDUSTRY'S RIGHT HAND

DENISON
EQUIPMENT *in* APPLIED
HydrOILics

Merits of Salt Baths and Air Furnaces

(*Continued from page 41*)

platform. After heating, the charge is quenched by merely lowering the ram and platform into the quenching pit. This is a very convenient method and requires much less handling than is necessary with salt baths.

Test results show that the metal temperature lag behind the chart temperature in these furnaces is dependent on both the size of the load and the gauge of the material. Actual test results for the various loads were as listed below:

Size Load	Gage	Metal Temp.	Furnace Temp.	*Time Lag
Small	.032	917 F	920 F	1 Min.
Heavy	.032	915 F	921 F	3 Min.
Heavy	.064	900 F	920 F	7 Min.

*Length of time required after furnace reaches set temperature for load to reach the same temperature.

Since the load in this type of furnace is handled as a unit, care should be taken in choosing the gages of clad material because the length of heating cycle must be set for the heaviest gage and if there is any light gage clad material in the load, diffusion through the cladding will be excessive.

Should the necessity arise, it is possible to change the heat-treating temperature from one charge to another in order to accommodate different alloys. For some applications this might be a very important factor. In addition to heat-treating wrought alloys, it is also possible to heat-treat castings in these air furnaces. In cases of extreme necessity it has been possible to artificially age alloys in them, although it is rather difficult to adjust them to the correct temperature since they are not primarily designed to operate at aging temperatures, which are in the neighborhood of 300-400 F.

Salt used in bath furnaces for the solution heat-treatment of aluminum may be either potassium or sodium nitrate or a mixture of the two salts. Sodium nitrate is the cheapest from the standpoint of cost per pound and has a melting point of 586 F as compared to about 425 F melting point for a 50/50 mixture. In some applications, such as annealing at temperatures in the neighborhood of 600-700 F, the lower meeting point would be the deciding factor. Whatever salt or combination of these salts used, they should be checked periodically for pH, since on continued operation they tend to become basic and will etch or pit the surface of immersed parts. This condition is controlled by the addition of potassium dichromate.

An internal electrode salt bath is started by melting the salt between the electrodes by means of a torch. In some air furnaces it may be necessary to use an oxidation preventative in the furnace while heat-treating bare alloy to prevent blistering. There are commercial preparations on the market for this purpose.

Our experience has led us to the following conclusions:

(1) Formed parts such as ribs, stretched skins, and long extrusions can be more efficiently processed in salt baths.

(2) Small parts such as gussets and short extrusions that can be racked and quenched vertically can be handled to an advantage in air furnaces.

(3) Alloys such as 14S and 17S which are heat-treated at different temperatures from 920 F, which is our salt bath operating temperature, are heat-treated in air furnaces.

Plant Layout—Subject to Change

(*Continued from page 35*)

To cite another example, at the present time the wing center section for the Liberator is started in upright bucks, then hoisted to a horizontal line for completion. Plans are underway now to break this section down into smaller units which will be made in individual bucks and jigs, then be joined together. This development will speed up wing fabrication considerably, but will involve a radical change in the entire wing center section department.

New tools and dies which American ingenuity creates at a steady rate tend to outmode factory layouts. Many parts formerly made on drop hammers are now being made on stretch formers, hydro presses or punch presses. Hand drilling is being supplanted by the introduction of pierce dies. A new method of splicing extruded parts is eliminating the necessity for joggling many parts. Heavy blanking presses are now doing much of the work formerly done by radial routers. Progress in tooling has been an important factor in the industry's steady climb towards a production goal of 10,000 planes a month, and nearly every improvement calls for some layout adjustment, if not a radical revision.

Another condition frequently encountered in aircraft plants is the discontinuance of one type of plane and the manufacturing of an entirely different design in the same buildings. A flying boat may be replaced by a land-based bomber, or a medium bomber by a fighting plane. The design life of most aircraft is limited in this era of rapid aeronautical progress, and experimental models designed to keep America in the aviation foreground seem to reach assembly lines regularly. As soon as one model starts down production lines, design engineers proceed to create another one incorporating new ideas in aerodynamics to take its place. This process invariably results in extensive layout changes.

The march of women into aircraft plants to replace men has been another factor requiring adjustments. Nearly 50 per cent of the employes in Consolidated Vultee's San Diego plants are women, and this has meant many changes to provide suitable facilities for them. Work benches have been lowered, smaller jigs constructed, and special handling equipment for tools is required in some cases to enable women to accomplish production work.

Modifications ranging from minor intra-departmental changes to rearranging entire buildings are constantly being made to keep the modern aircraft plant "in style" with the latest type of plane and the most advanced manufacturing methods.

Expensive changes, however, can be kept at a minimum by careful planning, especially by coordinating other departments which have a direct bearing upon plant layout. It is important that plant layout engineers know as far in advance as possible any proposed changes in customer contracts. The type of plane to be produced, the number and schedule of deliveries are of prime importance in overall planning.

Plans of the tooling and assembly planning departments must be considered, for in their planning is reflected the latest developments in tooling and the most recent techniques in processing materials and assembling them. Plant layout department at Consolidated Vultee is notified well in advance of the scheduled arrival of factory equipment, and upon delivery, plans are ready for its installation.

Production Control Department determines the schedule for production from the smallest part to the finished airplane. When the switch to speed up production lines is turned, and the lines seem always to be in a state of acceleration, it is imperative that the way be clear of obstructions and that plant facilities are synchronized to permit smooth operation. Plans of the production control department should be known at all times in order to correlate all factors influencing production.

Where the policy is to sub-contract on a large scale, conditions frequently arise which affect departments. Space for making a small assembly may become vacant if that part is sub-con-

tracted, and prompt utilization of available space is essential from an economy standpoint. So it is important that plant layout engineering be informed of plans of the Sub-contract Department whenever they may affect factory operations. The Time Study Department is another one which contributes valuable information, and consideration of data prepared by them is of vital importance in making changes.

Generally, it can be said that there are three principal objectives for plant layout engineering when changes are considered: (1) To reduce to a minimum the distance parts must move during the manufacturing and assembly processes; (2) To keep them moving with a minimum of impedence; (3) To use labor, space, and equipment most effectively. The overall purpose, of course, is to speed production and lower unit costs.

The modern plant must run with precision timing, and to attain the three objectives calls for the synchronization of innumerable factors. Fabrication departments must produce enough to feed detail assembly departments, which in turn must amply supply major and final assembly lines. The entire mechanism must move smoothly and in one general direction.

Considering the first objective, it is not always feasible to arrange departments so that every part travels over the shortest distance because of the multitude of different parts fabricated. This problem is encountered in the sheet metal department where approximately 20,000 different parts are made. In order to make the most efficient layout for the greatest number of parts, a percentage flow table in this type of department has been found very useful. Analysts study operation sheets for a sufficient number of representative parts to develop a flow diagram. These sheets show the order in which various operations are performed. A chart prepared from these data will indicate where each group of machines such as punch presses and drill presses receives parts from and where they are distributed. The machines can then be grouped relative to each other to achieve the greatest efficiency.

As a result of using a percentage flow table for the sheet metal department, it was found that equipment could be located so that approximately 80 per cent of the 20,000 parts would flow in a straight line. By spotting a few machines as a result of supplementary study, back-tracking was practically eliminated.

In departments where each part takes the same general path, straight-line arrangement can easily be determined. This is usually apparent without a detailed study of operation sheets, particularly in assembly departments. Not only is it important to arrive at a straight line flow, but the position of each machine should be an individual study of its own. Time study information and load figures are used in determining the most efficient position for equipment.

The main objective in planning a straight-line flow is to reduce the expenses incurred in material handling. There are two methods on which a large plant can be arranged—on a strictly departmental basis, or on a functional basis. If organized on the latter basis, parts will flow not only in a straight line in each department, but from one department to the next. This method tends to remove departmental boundaries, but reduces handling considerably. In a large aircraft plant hundreds of thousands of pounds of materials are handled daily. Every movement is expensive. So the layout engineer, when considering changes, keeps the possibility of arriving at a functional basis as the ultimate goal.

The second objective is to keep parts in a state of perpetual motion, a condition which layout and production engineers always hope to achieve. From a purely financial standpoint, parts can be looked upon as borrowed dollars on which interest is being paid as long as they are in possession of the company. If parts are allowed to accumulate in departments, the investment in work in process can reach excessive amounts with an adverse effect on costs. Continuous flow reduces the size of accumulation areas and stock rooms, and these dams which impede the flow of parts should be kept to minimum size.

Layout engineers look upon the manufacture and assembly of parts as sort of a relay race, with machines and departments arranged in such an order that parts can progress expeditiously to completion. If parts are not actually in process of manufacture they should not be in a fabrications department.

This calls for a careful balance of machines and for efficient transportation facilities for parts from one operation to the next. A sufficient number of machines in each group should be provided in order that they can absorb any reasonable influx of work. A shortage of machine capacity invariably results in an accumulation of unfinished parts on factory floors. In this connection, long-range planning will reduce the necessity for expensive rearrangements.

The methods of moving parts from one operation to the next is a problem of vital importance. If facilities for moving parts are not available when needed, a traffic jam usually occurs. Here again in the aircraft industry difficulties are encountered due to the thousands of different sizes of parts and assemblies.

One transportation job at Consolidated Vultee involves the moving of an assembled wing of a Coronado PB2Y-3 weighing 22,000 pounds, and another is moving a one ounce bag of rivets. Because of the diversity in weight and size of parts, mechanized conveyor lines are not utilized as extensively as in some other industries where standardization has been reached. We have provided mechanized lines, roller conveyors, and overhead trolleys wherever feasible to keep material moving.

In connection with moving material, it is not only a matter of transporting items from one point to another, but the position of the material upon delivery is a factor to be considered. Are conveyor lines located so that parts arrive at an operation station at the right height? An adjustment in transportation facilities is often necessary when the nature of the material handled changes. In other words, handling equipment should be designed for the product where the volume is large enough, or where unique problems are involved. The entrance of women workers into factories has meant major changes because of legal limitations on the amount of weight which they can lift.

The third objective, when changes are considered, of utilizing labor, space and equipment most effectively is highly important from a competitive standpoint. Unit costs of a product are determined one way or the other depending to what extent the investment in floor space and equipment is used for production. Idle machinery means that depreciation which is a substantial cost item in a manufacturing plant must be absorbed by a smaller number of units, with a consequent increase in unit costs. Idle machinery due to improper scheduling or inadequate transportation facilities often means idle labor which becomes an expensive factor in costs.

A plant may be looked upon as an aircraft engine in which the highest amount of horsepower output with the lowest possible weight is the objective. In a factory, the greatest output in the form of completed units with the smallest possible investment in capital assets is the objective of plant layout engineers. This means that the capacity of production should be as high as possible with a minimum of work in process at any one time. Like engine refinements, improvements in layouts to attain greater efficiency can always be made.

The number of employes should be distributed throughout a plant to prevent concentration of large numbers in limited areas. Inefficiency invariably results when employes are crowded together, and the trend has been to break planes down into smaller component sections so that employes can be distributed over a larger area. This provides more freedom of assembly and permits more simultaneous operations—an important factor in mass production.

The width and location of factory aisles is a factor to be considered in the proper utilization of floor area, and this point is sometimes overlooked. These traffic lanes should be adjusted whenever a change will reduce the distance which personnel and material must move.

The formal procedure for making a typical layout change at Consolidated

HYDRAULIC ENGINEERING

Of a tank recovery unit, equipped for servo-steering with Eaton Rotor Pump, LIFE (Nov. 8, 1943) reports, "The unit . . . will go up and down 50% slopes, through sand or underbrush, steering as easily as a passenger car on a smooth road." This is one of a number of military vehicles utilizing the Eaton Rotor Pump for such purposes as servo-steering and braking, engine cooling, lubrication, torque converter, fuel feed, and a variety of other applications. In the planning stage of these vehicles Eaton hydraulic engineering facilities were provided for the design of hydraulic systems. The same services will be available when, at the proper time, post-war vehicle and aircraft designs are undertaken.

THE EATON ROTOR PUMP IS ENGINEERED AND MANUFACTURED BY THE WILCOX-RICH DIVISION OF EATON MANUFACTURING CO., 9771 FRENCH ROAD • DETROIT

EATON ROTOR PUMP

Vultee's San Diego plants consists first of a survey by analysts of the parts to be fabricated or assembled. Operation sheets are studied and flow diagrams prepared where the flow is not immediately apparent. The use of paper or wood templates cut to scale is indispensable in planning the arrangement of machines and equipment within a department. Three dimensional studies with models are sometimes used.

It is found usually in a moderate sized department that there are many possible arrangements. Although the flow diagram dictates the general layout, there are innumerable details to be considered. Here especially is where templates or models greatly facilitate solution of a layout problem. The plan developed in the template stage is proven by factual data wherever possible and is approved by all departments concerned.

After approval, it is turned over to a draftsman. Signatures of department heads are obtained on the drawing, from which several copies are reproduced. In our case, drawings with copies of specifications of the work to be performed are then sent to Plant Engineering Department for completion.

One of the important factors in connection with making changes in a plant is to establish a cooperative working agreement with plant engineering, or the department or contractor assigned to do the actual work of locating equipment, building facilities, etc. When the actual work gets underway, plant layout department should maintain close contact with the project as the work progresses. At Consolidated Vultee's San Diego plants, we handle an average of 70 layout changes every week. These range from moving a work bench a few feet in a department to rearranging entire buildings. They must be made without interrupting production—they can be made without interference by scheduling the projects and by following them through to completion.

The war has been one of movement, not only on the battle fronts but on the industrial front where it is likewise considered strategically sound to keep moving.

Napier Sabre 2200 Hp. Engine

(*Continued from page* 32)

changed by means of opposed conical clutches, between which is a double conical male member moved hydraulically to engage either the low or the high speed cone.

The carburetor is a four-choke updraft S.U. type and incorporates automatic altitude and mixture enrichment controls. There is an automatic boost control, but this is a separate unit mounted on the supercharger casing.

From the supercharger volute the mixture is fed through four outlets to light alloy cast manifolds, one for each bank of six cylinders. Exhaust ports are between the upper and lower rows of cylinders, each pair of ports having a single ejector nozzle. Efficient damping of the exhaust flames is effected by these ejector nozzles.

Auxiliaries on the upper and lower sides of the crankcase are grouped on crankcase covers and actuated by shafts driven from the reduction gears. Above the crankcase are two B.T.H. duplex magnetos, two distributors, Heywood air compressor, Pesco vacuum pump, Dowty hydraulic pump, propeller constant-speed governor and electric generator. Below are the coolant pumps and the lubricating oil and fuel pumps.

At the top rear is a Coffman combustion type (cartridge) starter, which drives the upper crankshaft through the hand-starting gear. The cartridge magazine enables five consecutive starts to be effected from the driver's seat.

For lubrication there are high-pressure and low-pressure systems. High-pressure oil is fed to the main and big-end bearings and the reduction gears, while the low-pressure system serves the sleeve and accessory drives.

The coolant is an ethylene glycol-water mixture, which is circulated on a pressure system incorporating a ring-type header tank located around the nose casing and full thermostatic control which by-passes the radiator when the engine is warming up or if the operating temperature falls for any reason.

With a dry weight of 2360 lb and a maximum output of 2200 hp, at 3700 rpm the specific weight per bhp is 1.07 lb, a creditable figure for a liquid-cooled unit.

Pistons in German Aircraft Engines

(*Continued from page* 21)

ture, it is possible to obtain an indication of the operating temperatures. The isothermals of the BMW 801A-1 piston contained in the accompanying sketch, were obtained in this way.

Macrostructure

The grain flow, as observed in etched sections prepared on a plane normal to the crown and through the wrist pin bosses showed practically identical features in each case. At the center of the crown the flow lines were practically parallel with the external surface, but at the internal surface the metal in contact with the die had remained practically stationary. At the sides of the piston the grain flow followed a direction practically normal to the crown, so that above the wrist pin bosses the flow lines emerged at an acute angle to the surface of the crown. The grain flow in the lower portion of the wrist pin bosses was practically parallel with the wrist pin axis.

Microstructure

In order to investigate the method of manufacture the microstructure in planes normal to and parallel with the crown was examined. The methods of manufacture adopted for the four types of piston had evidently been very similar. In specimens prepared parallel with the crown surface the original eutectic network remained largely undisturbed whereas at right angles to this direction the microstructure showed fairly well-defined flow of the constituent particles. The eutectic areas remained, however, and merely showed elongation in the direction of flow.

The majority of the pistons had been manufactured of the eutectic silicon-aluminum alloy. In the samples examined, however, the fine modified structure normally associated with this alloy was not seen and the influence of the modifying reaction seemed to have been dissipated largely prior to solidification. The Bramo-Fafnir piston showed fine particle size.

The general features observed in the samples examined are those of pistons produced by pressing in dies, from extruded blanks, the close internal limits to which these pistons had been manufactured being typical of the press forging method of production. The appearance of the microstructure is regarded as indicative of extruded stock, although the degree of reduction in extrusion had not been great. It would appear that the Germans have adopted a standard manufacturing procedure and have practically standardized an alloy to be used for pistons. The procedure adopted constitutes a simple and economical mass-production method and provision for the variation in engine conditions seems to be made by ribs on the underside of the crown and by adjustment of the machined contours of the crown surface.

The pistons would be regarded as of good general quality, although the rather inferior microstructure of the BMW, the Mercedes-Benz and the Jumo pistons would not be expected to be accompanied by the best properties. It seems that the German manufacturers do not consider modification of the eutectic silicon-aluminum alloy to be important and evidently permit coarser particle size than is normally considered to be acceptable.

The Metal Market After the War?

(*Continued from page* 18)

ments it contains. This tendency is likely to be reflected more strongly in the postwar steel buyer's attitude than it has in the past.

According to a recent release by Secretary of the Interior Harold L. Ickes, primary aluminum is now being produced at an annual rate of 1,128,000 tons or, inasmuch as aluminum is quoted and sold by the pound, more than 2,250,000,000 pounds. In 1941, December of which year brought the Pearl Harbor sneak attack by the Japanese, production aggregated 615,000,000 pounds and before Great Britain's declaration of war on Germany in 1939, the annual U. S. production of aluminum was 325,000,000 pounds. So since then our output of aluminum has increased to seven times what it was five years ago.

Current output of secondary aluminum is estimated to be at the rate of 58,000,000 pounds a month or 700,000,000 pounds a year. The market price of this remelted aluminum is quoted at 11 cents a pound while the OPA ceiling price is 12½ cents. In a way, this difference between what might be charged for secondary aluminum and the market is expressive of the excess of the supply over the demand, a condition even more eloquently borne out by top-heavy accumulations of scrap in producers', dealers', and smelters' warehouses.

For primary aluminum 15 cents a pound is the current quotation. Aluminum of comparable quality was quoted at 20 cents a pound when the war in Europe broke out. Back of these developments was the fact that the war afforded the opportunity to produce aluminum on a scale and by volume production methods.

Induced by the high wartime production of aluminum, there has developed animated discussion among engineers and metallurgists of the possibility of a much wider use of the metal in automobiles. Aside from a number of advantageous physical properties possessed by steel, cost comparison would seem to weigh heavily against large scale substitution of aluminum for steel. Making full allowance for reductions in aluminum prices, Edgar C. DeSmet, executive engineer, Willys-Overland Motors, Inc., reached the conclusion that, even if a majority of body parts were made of secondary aluminum, they still would cost two-and-a-half times as much as would those made of steel.

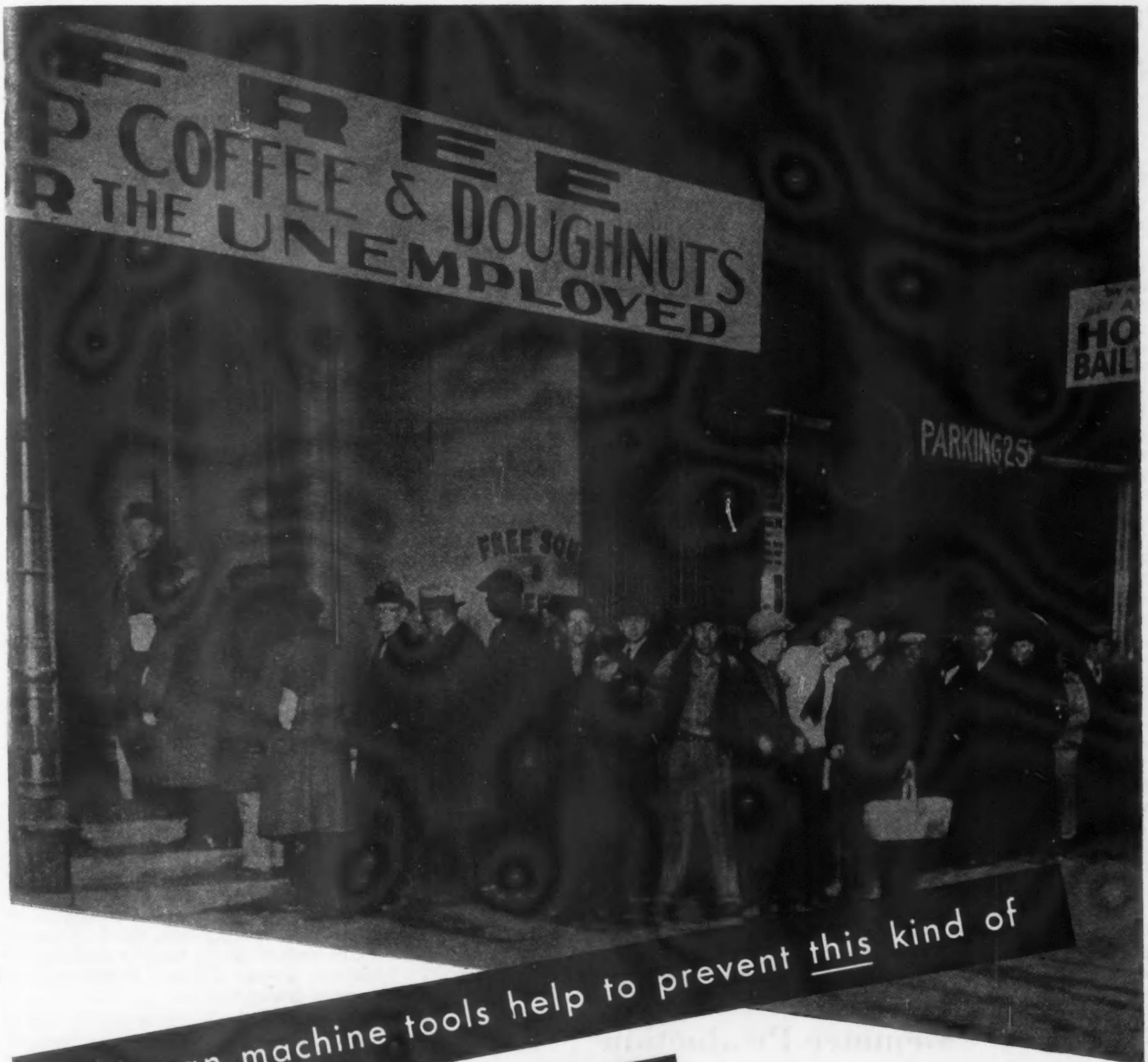
The unprecedented crop of aluminum turnings and other scrap in the last three years has apparently so dislocated the market for secondary metal that today it is considered an entity by itself without primary market ties. Far from being blind to this condition, the aluminum industry's postwar plans are built on recognition of the fact that for several years following the war its chief concern will have to be the whittling down of the unwieldy accumulations of secondary material. For about two years after hostilities end, with automobile production in full swing, no change in the ratio of aluminum to steel content of automobiles and motor trucks is looked for and even when ingenuity of design and engineering once more have come into their own, a free flow of secondary aluminum is forecast for parts in which aluminum long ago established its merits.

Right here one may be permitted to pose the question of whether those who seek to appraise the long range possibilities of the postwar period are not leaning too far backward in their efforts to avoid the impression of being over-sanguine in their outlook. A country that before the war had become accustomed to an annual output of 3,500,000, cars and that has lacked replacements for nearly three years, at least for civilian use, is likely to want to make up this need as speedily as possible, once wartime barriers are even only partly raised. Granted that it will take months to bring back millions of men from the camps and different theaters of war, the continuing high rate of metal production and the huge reserves that have been built up, are visible proof that a resumption of production all along the line is feasible and that the pent-up demand will furnish strong initial support and the necessary momentum. Isn't it possible that suppressed demand, accompanied as it has been by increased in purchasing power, will push old landmarks of civilian consumption much higher?

Under the influence of record-breaking demand from the aviation industry, magnesium is now being produced at the rate of nearly 30 times what it was at the outbreak of the war in Europe. In fact, magnesium capacity has been lately referred to as having grown to 600,000,000 pounds, which would be about 50 times what it was at the beginning of the present decade. Most of this expansion took place last year, and the Department of the Interior noted that supply exceeded consumption throughout 1943 and industry stocks had a marked increase in that time. Magnesium, in 99.8 per cent ingot form, is currently quoted at 20½ cents. The price of this grade in 1939 was 27 cents a pound and the approximately 30 per cent reduction in price since then has come about gradually, there having been two reductions of one cent a pound in each of the last two years. Both the past history of the magnesium market and engineering opinion bear out the belief that the metal's future is intertwined with that of the aviation industry, which is credited with being able to pay a premium for the weight saving that the use of magnesium entails.

Smelter production of copper from domestic ores displays a virtually stationary appearance. While the ban on some statistical information has been lifted, there is still a veil over the very data needed to present a clear picture of the supply-demand situation, especially so concerning imports and stocks. When the British government recently was reported to have ordered a 20 to 25 per cent cut in Rhodesian copper production, the trade in New York was greatly perturbed by lack of the very information that might have thrown some light on this move. Between the lines of official reports one can read disappointment that the response to premium offers fell short of expectations, but from Denver comes a statement by J. B. Haffner of the Western Division of the American Mining Congress, who is quoted as declaring that "present overproduction includes all the heavy metals and most of the light ones; shortages exist only in metals used in extremely small quantities." It would seem, therefore, that there need be no uneasiness over the supply of copper and zinc, the two brass-making metals. This is, moreover, borne out by copper market conditions, in which the ceiling price of 12 cents is being shaded to priority-qualified buyers. Both the copper and zinc markets, while quoted higher than when buyers had the upper hand in prewar days, have been held down by OPA to so reasonable levels that they are no impediment to the resumption of free markets.

As for the outlook regarding tin, it should be borne in mind that: (1) we had, according to those in a position to make a worth-while appraisal of the situation at the time we got into the war with Japan, a considerable reserve of tin; (2) despite the recent political upheavals in Bolivia, we are reported to have been receiving uninterrupted shipments of concentrates from there; (3) non-essential uses of tin have been forbidden since the outbreak of the war, and (4) the velocity of the flow of scrap tin through the stages of collecting and reclaiming has been greatly increased as well as the amount of tin used in the production of tin plate impressively lowered through an improved process of deposition. It seems more likely, bearing all this in mind, that, and wisely so, we are erring on the side of safety. Sight also must not be lost of the wide use of silver in bearing and brazing metals and the addition of silver to the roster of important industrial metals is likely to make further and enduring progress in postwar days.



How can machine tools help to prevent <u>this</u> kind of

Victory?

Remember the big parade of the breadline— the march of the bonus army — the victorious men selling apples? Many an American hero tasted those bitter fruits of victory, and the war to end war ended nothing.

What kind of victory will this one be? *It can* be the great one American boys are giving their lives for — but they alone can't make it so. For victory in peace, as in war, must be planned ahead . . . and in peace, *you're* one of the Generals.

If you are a manufacturer, there is a small group of basic machine tool engineers who can help you to plan now for the kind of victory we've told our sons they're fighting for.

One of these engineers is a Bryant man. We urge you to call him today. For his specialized knowledge of internal grinding machinery is important to the manufacture of literally *everything* that will make this country a finer place: this victory a victory that we shall not be ashamed of.

BRYANT

BRYANT CHUCKING GRINDER COMPANY SPRINGFIELD VERMONT, U. S. A.

Drop Hammer Dies for Short Production Runs

(*Continued from page 33*)

aluminum, and 1% magnesium) has been maintained at the proper pouring temperature—no higher than 850 F, and no lower than 810 F. The stamping surface of the die, as represented in the sand mold, is brushed with a coating of graphite to prevent the sand from clinging to and graining the surface of the die. Pot paint is used in place of graphite by many companies, as it serves the purpose of making the sand particles adhere to each other. However, it proves as tenacious in regard to sticking to the die surface and presents problems in the finishing. If graphite remains, it is of no consequence.

After the coating has been applied, the entire inside of the matrix is dried with a blowtorch to prevent steam bubbles in the molten alloy. Then the mold is ready for use. The pot is skimmed and the pre-heated ladle fitted and emptied into the gate, while a skimmer is held to block the force of the flow of metal at the entrance to the die, so that the walls of sand will not be destroyed. If the ladle holds insufficient metal to fill the entire form, a hand ladle must be used to keep the metal flowing into the gate and prevent solidification of the alloy there. This and keeping the skimmings floating, to prevent their lodging and forming imperfections in the body of the die, are important rules in the pouring.

To stop the too rapid cooling on the large open side of the die, which would pen in the molten metal below and force all of the shrinkage from the face—where the most precision is necessary, asbestos blankets are spread over the top, replacing the charcoal that was formerly used for this purpose. When the die is cold, any adhering sand is washed off, the bottom is planed smooth, and the pressure surfaces are ground and burnished. This operation completes the die.

The punches are molded directly from the dies that are their mates. The die is heated, clamped right side up in a wooden frame, and plaster of Paris stems the escape of the molten lead from the cracks at the junctions. The surface of the die is brushed with French chalk, and lead, hardened by the addition of 7 per cent antimony and heated to about 770 F, is poured into the frame.

This metal is still much softer than the zinc alloy used for the die, and is chosen particularly because the metal flow in the finished punch compensates for any anticipated play in the hammer and tends to adjust itself with each blow.

Inserts, fitted with bolts and cones, are set into the hot lead in the frame and positioned by a jig. Before the punch is completely cool, the jig is removed, the cones and bolts broken loose and taken out, leaving the insert by which the punch is to be attached to the ram of the drop hammer. When the punch is cold, the frame is removed, and the punch, still resting in the die, is planed smooth and parallel with the bottom of the die. Then the surface is cleaned for parts clearance, and it and the die are ready for service.

Gemmer Production

(*Continued from page 26*)

of the major steps in the process have been developed by improvisation. This aspect of production management will be noted as we go along.

Consider the column. This starts as commercial tubing in long lengths which are cut to rough lengths. First machine operation is the turning of OD chamfer and cutting to length on Bardons & Oliver lathes. Then follow a series of swaging operations on both ends on Etna Swagers to produce the tapers and undercuts. One end has serrations for locking the steering wheel. Instead of cutting these by conventional methods—by hobbing or milling—they are produced rapidly and more accurately by shearing, using a special multiple shearing head set up in a vertical Fox press. Prior to this operation, the shafts are fed into a large Cone automatic for chamfering the ID, and the forming and cutting of threads at one end. The keyway in the lower end is cut in a Cincinnati mill.

The worm blank is produced on Cone automatics. Perhaps the most ingenious operational set-up on this part is the cutting of the relief and finish forming of the seat for the anti-friction bearing. This is done on Sundstrand lathes fitted with special tool attachments comprising a series of front and rear angular slides arranged to feed in automatically. Another novelty is the cutting of the special helix form. This is done on Lees-Bradner hobbers which were rebuilt and provided with special heads. Here, too, the conventional procedures were discarded. The job is done with the cutter mounted on the work spindle while the blank is mounted on what is ordinarily the cutter spindle. Key to the accuracy of this operation is a special method of locating the blank from the previously machined bearing surface.

The factory routing for the worm outlines the various operations in detail, including steps on Lo-Swing lathes, grinding on Norton and Cincinnati grinders, threading on the Landis automatic threading machines. Due to the steps involved in selective heat treatment, the work is carried through a number of degreasing operations in Detrex machines.

Most of the operations of turning, boring, and drilling of the housings are performed on drill presses, some using 8-spindle hollow-mill tool set-ups for turning and facing in place of conventional handling on lathes or turret lathes. This is still another aspect of ingenious improvisation in which the fixture is employed to provide accuracy of alignment, thus permitting the full utilization of available equipment. Only function of the drill press in this instance is to provide rotation and feed for the floating tools.

The gear shaft is another of the major parts for which an interesting production technique has been developed. This starts as a forging—normalized, and shot-blasted in an American Wheelabrator. Then follows a combination of the specialized techniques mentioned earlier. First is the application of surface broaching to simplify the formation of surfaces ordinarily handled on individual milling machines. One operation is done on a Footburt which forms a spherical seat on the fork end and is followed by a set-up on another Footburt for broaching the inside of the fork. Gemmer, said to be one of the earliest users of surface broaching, utilizes this method intensively wherever it offers economic advantages. It will be noted that still another surface broaching operation—the rough and finish of the inside surface of the head is done on one of the several Colonial broaching machines found here.

Unusual, too, is the use of a Landis Machine Co., double-head automatic threading machine converted for turning the formations on the shank. This employs a die-head with special cutters, speeds up the operation manyfold as compared with the engine lathe used on smaller runs. The drilling, reaming, and countersinking of the two holes in the fork are done on a special Ex-Cello-O machine designed for the purpose. The shank end operation noted above is ground in a Cincinnati Centerless, then mirror-ground in a Cincinnati Centerless Lapper.

One of the most exacting steps is the assembly of the needle bearing rollers and shaft with the roller tooth in the fork end of the gear shaft. This done in an air-conditioned booth by selective assembly methods. Following this, the bearing pin is riveted in place at both ends by upsetting in a resistance welding machine.

The roller tooth which is incorporated in this assembly, together with the thrust washers, are lapped to a mirror finish in Norton Hyprolap machines to provide the nicety of anti-

friction and wear-resistance for which the Gemmer gear is noted.

Pitman arms are ofttimes intricately bent forgings with a ball end. They start as a straight forging, normalized and shot-blasted. The ball end is turned to spherical shape in a lathe set-up employing a special turning tool. After bending the arm, the ball end is heat treated and polished, then cyanide hardened. The required bending of the arm is done hot in a forging press, using a special die. The action of the die is to roll a hinged section over the arm, bending it to the proper formation. Some years ago this was a blacksmith operation with the bending done by hand over an anvil.

As noted earlier, the machine shop departments for components of the steering gear assembly are lined up in about the sequence in which such parts enter into the final assembly. The operations proceed from one side of the plant to the other, terminating at the assembly lines. First operation here is the preparation of sub-assemblies on a table conveyor. Sub-assemblies then proceed to the final assembly conveyor for completion of the gear. The end of this line feeds to the overhead monorail inspection conveyor on which the assembled units are hung. As the assemblies move on the closed conveyor, skilled operators pick them off and complete the adjustment and final inspection.

In summarizing the Gemmer operations, it is evident to the observer that the chief activity lies in the production of steering gear assemblies for essential vehicles for the war. The other products, foreign to this activity, have been introduced to maintain operations at capacity. Observation indicates clearly that in all cases, skillful improvisation has made it possible to utilize existing equipment to the fullest extent in the manufacture of components for all of the products made in the plant. In fact, the acquisition of new equipment was confined to those operations that required specialized machinery owing to the nature of the work.

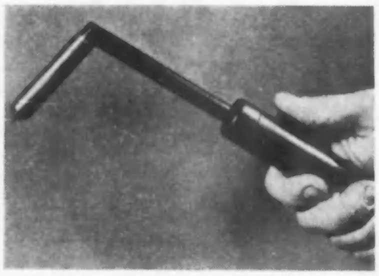
In addition to the manufacturing facilities noted briefly in this article Gemmer has a comprehensive laboratory for carrying on the necessary research in chemistry and metallurgy; also mechanical laboratory facilities for the testing of steering gear components and assemblies.

Finally it may be noted that the wartime emphasis upon heavy duty steering gears has served to provide an excellent background for extensive participation in heavy duty steering gears for the postwar market, thus broadening the field of an organization which in the past devoted most of its activity in the passenger car field.

Since it is a difficult task at best to provide a word picture of an extensive manufacturing operation, we have selected some pictorial views in various corners of the plants so as to afford a better visualization of the range of activity.

New Production Equipment

(*Continued from page* 43)



G-E helium shielded arc-welding electrode holder

ply valve is located on the handle of the holder. This button will remain in either the ON or OFF position without being held. It also operates the valve in intermediate positions, thus providing stepless control of the gas flow and enabling the operator to conserve helium when welding in a corner or a depression.

SURFACE-ROUGHNESS measurement of piston rings is aided by the introduction of a new piloting fixture by Physicists Research Co., Ann Arbor, Mich. The side surfaces of all types of rings, including keystone rings, may be measured with the Type R Fixture, which works in conjunction with any Profilometer.

The ring may be measured in three ways; by tracing circumferentially; by tracing radially at one place on the ring; and by a combination of both at the same time. Operation is wholly automatic, with switches provided for selection of the type of stroke desired. An automatic shut-off is provided to stop rotation of the ring as the gap approaches the diamond point, where damage might occur.

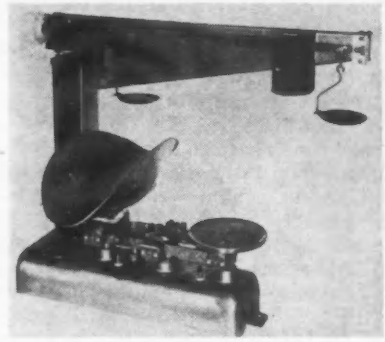
The fixture is intended for production checking of piston rings. The Tracer is automatically advanced and retracted for measuring each ring. Rings are easily inserted and removed, and very little adjustment is needed to handle rings varying from 2 in. to 10 in. ID. The same is true for keystone rings.

The Type R Fixture weighs 95 lbs and measures 10 in. by 22 in. by 7½ in. Operation is from 115-volt, 60-cycle power lines.

THE piloted cylindrical plug gage, manufactured by Vard Inc., Pasadena, Cal., is particularly adapted to gaging holes which must be held to very close tolerances and also to gaging on machines where pieces to be checked cannot be removed. The special design speeds up the gage's entry into holes, even when the hole is only .0001 in. over plug size. Such a self- aligning gage eliminates feeling or steering and is said to make it possible for even an unskilled operator to use this gage with excellent results.

Vard piloted cylindrical plug gage

A Vard piloted gage will enter holes where tolerances are close more readily than unpiloted gages of the same size, because the pilot aligns the gage with the axis of the hole to be gaged. The Vard piloted cylindrical plug gage is made in two types, one for gaged open bores and one for blind holes.

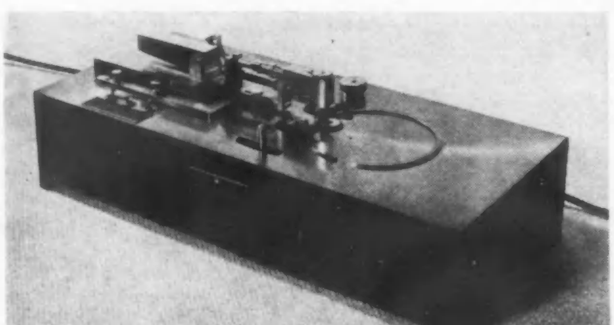


Detecto-Gram counting scale

A HIGH accuracy Detecto-Gram counting scale has been added to the line of industrial scales manufactured by Detecto Scales, Inc., Brooklyn, N. Y.

This Detecto-Gram model No. 66-02 was designed to speedily and accurately count very small, light pieces.

The scale has a sensitivity of 1/64 oz. and is equipped with a special over and under dial which immediately shows up a descrepancy of one piece more or less than the desired count. The two counting pans are arranged on a 10:1 and 50:1 ratio. The capacity of this scale is 6 lbs.



Type R piloting fixture made by Physicists Research Co.

Cylinder-Bore Wear and Corrosion

(*Continued from page* 38)

if we could be sure that they would retain these characteristics over a long period.

Where there is much cylinder distortion, the rings should be pinned to prevent rotation and to lessen blow-by. If materials were available that would ensure maintenance of these characteristics, we could hope to eliminate this factor of blow-by. The pressure behind the top ring also may have an influence on wear. This pressure is affected greatly by the fit of the top land in the bore. The length of this land also is important. But as soon as corrosion in the critical area becomes serious, the best pistons in the world lose their fit, and the rings then are at the mercy of destructive temperatures and pressures. Temperature variations which affect the diameter of the land also may affect its clearance. The temperature of the piston top will be affected by a wet mixture, being lowered by the evaporation of fuel, so that the clearance is increased.

Spark Timing

Another factor affecting bore wear is spark timing. It is the controlling element in the relative phasing of the maximum pressure point of combustion, and the relative position of the ring in its groove. Maximum pressure normally

DIVISIONS: MACHINERY — AUTOMOTIVE — ELECTRONICS

comes just after top dead center. If the spark is advanced, the pressures are higher and occur earlier. Investigation has shown that an increase in wear rate with 5-degrees over-advance may increase bore wear by from 50 to 100 per cent. Since spark advance in the different cylinders may differ as much as 7 degrees, owing to imperfections in the distributor, 5 degrees is not very much latitude, and this may in part account for the fact that rationalization of bore wear is a very elusive problem.

Effect of Fuel

Unquestionably, another very important factor is the fuel itself. Five years ago I made the statement that "much work will be done in the near future to rate fuels experimentally for their effect on bore wear." The war has made this study necessary, and the Bureau of Standards is conducting corrosive and wear tests with an assortment of fuels and substitutes.

Fig. 4 shows the comparative wear of a German engine using two kinds of fuel. The bad wear was produced with a national alcoholized fuel of a low order, which prior to the war was in common use in Germany. The other fuel was of aviation quality and free from additives. The engines under test were not designed to insure quick warming of mixture or water and the German piston rings were not particularly effective for blow-by or oil control. The bores were relatively starved for oil, and what little film did exist, undoubtedly was weakened by blow-by. There is, of course, a great difference between the volatilities of a low-grade fuel blend and a fuel of aviation quality. It may be the lower temperature, due to latent heat of the wet fuel, that affects the bore wear adversely, or it may be a chemical reaction due to the additives. The solvent action of alcohol on the nebulous solids in gasolines is well-known. Lubricating oils and gasoline have a common origin and the alcoholic fuel may have a strong solvent action on the engine oil. Further, alcohol mixtures, unless properly balanced by light gasoline ends or their equivalent, will require a longer warming-up period, and therefore a longer use of the choke, whether automatic or manually operated. This would give an abundance of apparently "unfriendly fluid" in the combustion chamber. However, the very cautious recent experiments of the Bureau of Standards seem to indicate that with 95 per cent of alcohol and 5 per cent water, the wear by corrosion may be 30 per cent less than with commercial gasoline, and this in spite of the fact that the alcohol mixture must contain much more unvaporized fuel. The Bureau of Standards has succeeded in developing a cycle of tests that develop bore wear in a pattern exactly similar to road tests, the similarity extending to the variation among cylinders and to the pattern of the wear. The Bureau has pointed out that, from the standpoint of corrosive wear, in operation on a stop-and-go basis with a cooling off in between, commercial gasoline is worse than most substitute fuels containing alcohol, acetone, naphtha, and butyl. Under similar test conditions, the corrosive wear with any blend of these is less than with gasoline. However, with these special fuels the temperature of the cylindr walls has the same marked effect on cylinder corrosion.

To the list of essentials in the control of cylinder corrosion we may therefore add the following:

1. The leanest possible mixture for part-throttle operation.
2. Use of a type of fuel that will be well vaporized.
3. Uniform cylinder-wall temperature as high as possible within reason. This is affected by the method of water circulation and by the mixture distribution among cylinders.
4. Uniform spark timing for the different cylinders.
5. Protection for the upper 2 to 3 in. of the bore, preferably by a short insert of stainless or semi-stainless material.

The Oil Film, a Protection Against Corrosion

Experience has definitely indicated that if an oil film can be maintained

on the cylinder wall, the effect of the corrosive acids will be minimized. Therefore, it is important to study the elements in an engine that tend to destroy this protective oil coating. Important among these is blow-by, which it has been sought to render innocuous by the development of crankcase ventilators. Some engines it was found impossible to ventilate because the amount of gas passing the rings was greater than that which could be induced to leave the crankcase before it contaminated the oil. Crankcase ventilators can be roughly divided into two classes:

a. Those in which air is blown into the crankcase and provisions are made for its exit.
b. Those in which a slight depression is maintained in the crankcase and oil pan, equivalent to ½ in. of water gage.

With ventilating systems of the first class, air cleaners should be applied to the inlet to prevent further contamination of the oil by road dust, etc.

The second class is more difficult to develop, but it is more positive. There can be little doubt that if a depression equal to ½ in. of water exists in the crankcase under running conditions, no gas exists in this space. The author prefers this system, with which he has had more experience. Blow-by must be miniized before ventilators of the ejector type can be used. In fact, if the ordinary tubular ejector cannot maintain a depression equal to ½ in. water gage at 60 mph, the blow-by also will preclude long ring life, and bore wear and ring failure will quickly develop. If air leaks into the crankcase at such a rate that the ventilator cannot maintain a depression then dust will follow it. It is not easy to develop a satisfactory ejector-type of crankcase ventilator for low-speed trucks. For such conditions boosters must be developed to increase the air velocity past the ventilator outlet.

Piston Ring Design

Considerable progress has been made in America in piston ring design. From 1920 to 1927 American rings worked under a uniform radial pressure and were hammered to give that result. Such rings had an average diametral tension of 7 to 9 lb. The ratio of radial thickness to diameter was 28 to 1. The rings were finished with sharp corners, and there were several methods of casting them, the only limiting specification being that the product must be free from shrinkage strains. From 1927 to 1932 rings were in the main individually cast, to insure greater life and less blow-by. This was the period of development of crankcase ventilators. The average tension of these rings was from 9 to 11 lb. The ratio of radial thickness to diameter was 24 to 1, and hammering for shape was eliminated. The individually-cast ring with its cast in shape gave more consistent results, and took the place of rings shaped by hammering. From 1932 to 1940 the

diametral tension was increased to from 16 to 18 lb., rings being in the main individually cast, the radial-pressure pattern being controlled to give a maximum effect in a given engine. They were almost tailored for their job. During this period blow-by had become a serious factor, and maximum pressures and increased temperatures and speeds were making considerable demands upon the piston rings. Modifications were made in American rings to meet these conditions, and to shift the "break" in the blow-by curve.

Experience has indicated that $\frac{1}{2}$ to $\frac{5}{8}$ cu ft per min of total blowby throughout the useful speed range is an ideal allowance, and an amount which normal ventilators can handle. Ring chatter became troublesome and was eliminated by controlling the inherent pressure pattern of the ring. Chatter and maximum blow-by characteristics are dependent on the width of the ring. A $\frac{1}{4}$ in. ring always would be unsatisfactory beyond 3200 or 3300 rpm. A 3/32 in. ring is satisfactory up to 6000 rpm. This has been carefully checked, despite the fact that there are not many engines that run at 6000 rpm. Rings 3/32 in. wide, made of present materials are not durable. In Europe, since their production volumes were never as high as the American, they have experimented with special materials and undoubtedly have developed material combinations that are in advance of the American. It remains for us to combine the better materials with a process of casting that will combine the advantages of both methods. The centrifugally-cast pot of a specially developed material, cast to the same shape as the individually-cast ring may give us a ring that will not only measure up to demands for blow-by and oil-consumption control, but will give us these necessary controls over the longest period of miles (or hours) we have ever had.

Conclusions

From the foregoing we must conclude that wear by corrosion is complex and may be prevalent in any engine through minor failures of many individual adjustments. The area of corrosive attack is at the top of the bores. Therefore, a short insert of acid-proof material (Fig. 5), as used in several important engines in England, should solve the problem. For air-cooled radial aircraft engines, operating in cold air, a longer sleeve, extending over at least half the bore length, might be necessary, on account of the cold blast against the forward side of the engine. Further, since the oil film is an important factor, we must continue to protect it with the best possible rings, and a combination of more durable material, centrifugally cast, with pressure pattern control bids fair to give good service over a long period. Such rings, coupled with the stainless insert, should represent a worthwhile progress in engine design.

Model Proving Grounds for Nash Motors

Nash Motors Division of Nash-Kelvinator Corporation, has just purchased a large tract of land on which it will establish a model proving ground for the most exhaustive tests of postwar developments in Nash automotive design and construction. Although plans for constructing the new proving grounds have been drawn in detail, actual work will not be undertaken until later when military requirements for war have been reduced and manpower and materials are available for postwar work.

When completed, the new proving ground will be one of the most modern in the country, providing almost every kind of driving condition topographically conceivable and will be equipped to test in all types of weather conditions.

New Wrinkle in Rubber Gloves

According to the B. F. Goodrich Co., synthetic rubber gloves which have been packed for a long time and may look wrinkled and stiff on being unpacked, should be held under warm water for a few minutes. This will cause their normal snap and life to reappear.

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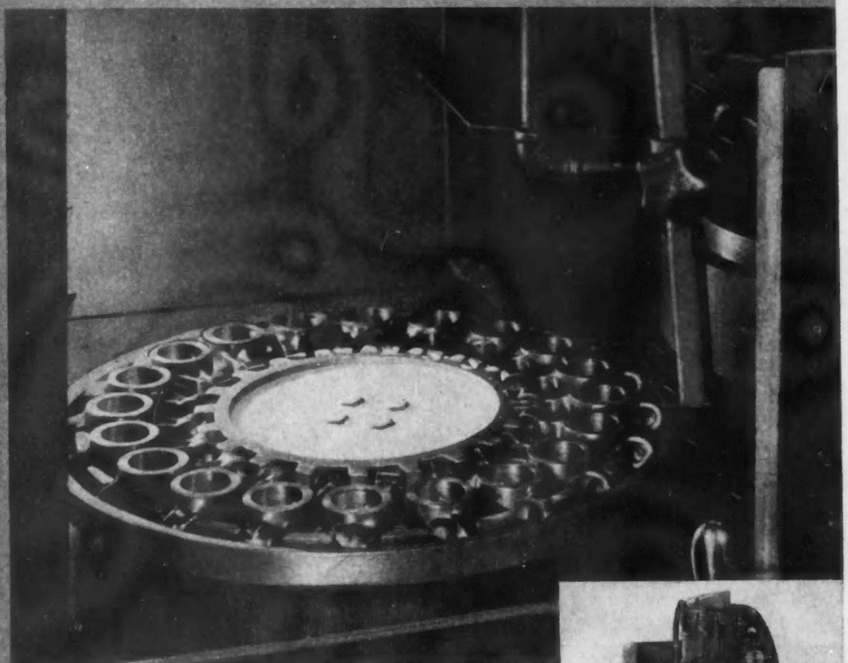

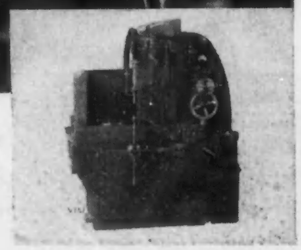

Grinding Steel Forged Rocker Arms on No. 11 Blanchard Surface Grinder

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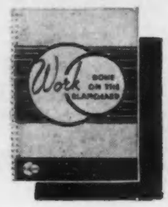


Send for your free copy of "Work Done on the Blanchard." This book shows over 100 actual jobs where the Blanchard Principle is earning profits for Blanchard owners.

PERSONALS

(*Continued from page 48*)

Warwick Mfg. Corp. has announced the appointment of **Reau Kemp** as sales director.

Jessop Steel Co. has announced the appointment of **Myron M. Eicher** as works manager. He succeeds **Harry Wilson, Jr.,** who recently was made vice-president in charge of operations.

AC Spark Plug Division of General Motors has reorganized its replacement sales staff with the appointment of three special assistants to **Wilson S. Isherwood,** general sales manager. **John C. Hines,** formerly Philadelphia regional manager, will specialize on spark plugs and **Alpheus S. Holmes,** formerly New York regional manager, will concentrate on oil filters, both with headquarters in Flint. **Richard E. Merrell,** formerly Chicago regional manager, will specialize on fuel pumps, speedometers and related items and will be located in Chicago.

Francis S. Norton has been appointed general traffic director for the Fisher Body Division of General Motors Corp. He succeeds **C. A. Sullivan,** who has retired at the age of 75 after 26 years as general traffic director.

Charles C. Fagan, formerly regional director for Africa and more recently in the Studebaker government procurement division office at Chicago, has been named vice-president of Studebaker Export Corp.

Montague A. Clark, formerly director of industrial and public relations for the U. S. Rubber Co. at Detroit and more recently Michigan director of the WMC until he resigned Dec. 1, has been named manager of the public relations dept. of Motor Products Corp.

L. A. Danse, formerly chief metallurgist for the Cadillac Motor Car Division of General Motors, has joined the staff of the Research Laboratories Division of GM. **A. H. Smith,** formerly a member of the technical staff at Republic Steel Corp., has succeeded Danse.

Frank A. Hiter, vice-president, has been designated senior vice-president of Stewart-Warner Corp. **William A. Patterson,** president of United Air Lines, has been elected a director.

Frank C. Barrows, Jr., formerly Detroit district manager, has been named automotive sales manager of Aluminum Co. of America.

Hugh M. Fenwick, former assistant to the executive vice-president of Consolidated-Vultee Aircraft Corp., has joined the Curtiss-Wright Corp.

Harry K. Werst, a partner in Booz, Allen & Hamilton, has been appointed vice-president in charge of manufacturing of Elastic Stop Nut Corp.

W. P. Hilliard, formerly director of sales and engineering, has been named general manager of the Radio Division of Bendix Aviation Corp. He succeeds Hugh Bent, who has been given a special assignment by the corporation.

Lee N. Brutus has resigned as president of Luscombe Airplane Corp., Trenton, N. J., having assumed the position in April, 1942, at the request of the Navy.

J. Cliff Roberts, formerly with D. P. Brother, Inc., and Ruthrauff & Ryan, Inc., on automotive accounts, has rejoined J. Walter Thompson Co., in the Chicago office as director of sales promotion on the Ford Motor Co. account. He served in a similar capacity on the Nash account several years ago.

Reichold Chemicals, Inc., Ferndale, Mich., has reorganized its research laboratories under **John J. Bradley, Jr.** Heads of the new laboratory divisions are **A. G. Hovey,** coating resins and patents; **Harry Kline,** phenol plastics; **Arthur C. Lansing,** chemicals; **Harold E. Weisberg,** chemical pigments; **J. Frank Maguire,** market research, and **Dr. E. F. Siegel,** special compounds.

CALENDAR

Conventions and Meetings

American Society for Testing Materials Spring Meeting, Cincinnati, Feb. 28-March 3

Northwest Aviation Exposition, Minneapolis Mar. 25-April 1

American Society of Tool Engineers—Annual Mtg., Philadelphia. March 26-28

American Chemical Society, Cleveland, April 3-7

SAE Natl. Aeronautic Meeting, New York April 5-7

Midwest Power Conference, Chicago, April 13-14

American Chemical Society Spring Mtg. of Div. of Rubber Chemistry, New York City April 26-28

Institute of the Aeronautical Sciences—Natl. Light Aircraft Mtg., Detroit, April 27

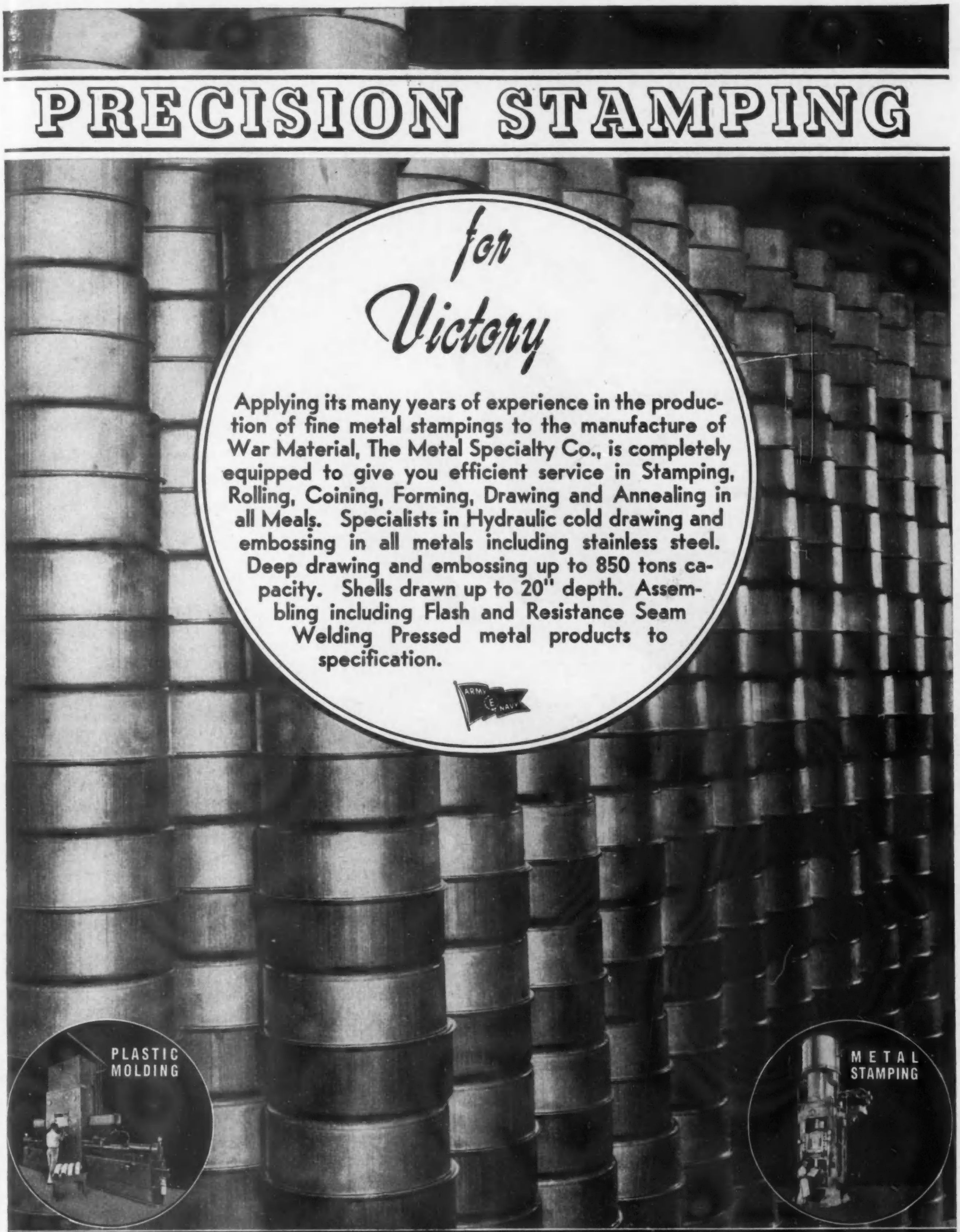
SAE Natl. Diesel-Fuels & Lubricants Meeting, Chicago May 17-18

SAE Natl. War-Materiel Meeting, Detroit June 5-7

American Society for Testing Materials (47th Annual Meeting), New York City June 26-30

SAE Natl. Transportation & Maintenance Meeting, Philadelphia June 28-29

SAE Natl. West Coast Transportation & Maintenance Meeting, Portland, Oregon August 24-25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Protective Coating and Camouflaging of Airacobra Parts

(*Continued from page* 19)

strength to make it usable in the structural components of aircraft, therefore it must be alloyed with small amounts of such elements as copper, magnesium, manganese and silicon to produce a material which may be fabricated in the soft state and subsequently heat-treated to high strength. Rivets are also made from aluminum alloy wire and are also heat-treated to produce the physical characteristics necessary in the fabrication of aircraft.

Available to the airplane manufacturer is high strength aluminum alloy sheet which has thin surface layers of commercially pure aluminum. This type of material has all the high strength properties of uncoated sheet plus all the corrosion resistance of pure aluminum. The aluminum of this type really constitutes a protective coating in itself.

The aluminum coating on such material has a higher electric potential than the underlying alloy and acts to protect sheared edges and drilled holes by virtue of electrolytic action. This tendency allows the manufacturer to devote less protective coating to material containing commercially pure aluminum coating, as compared with straight aluminum alloy stock. Widespread use of this "Alclad" has lessened to a degree the necessity of extensive treatment against corrosion.

A chromic acid dipping process has supplanted electric anodizing in many cases, and the dipping process has furthered the advance towards mass production of airplanes. Just recently completed at Bell Aircraft is a Chromodizing and Painting Conveyor Machine which has speeded up production many fold. The conveyor of the machine moves constantly, carrying screens of parts through the processing cycle.

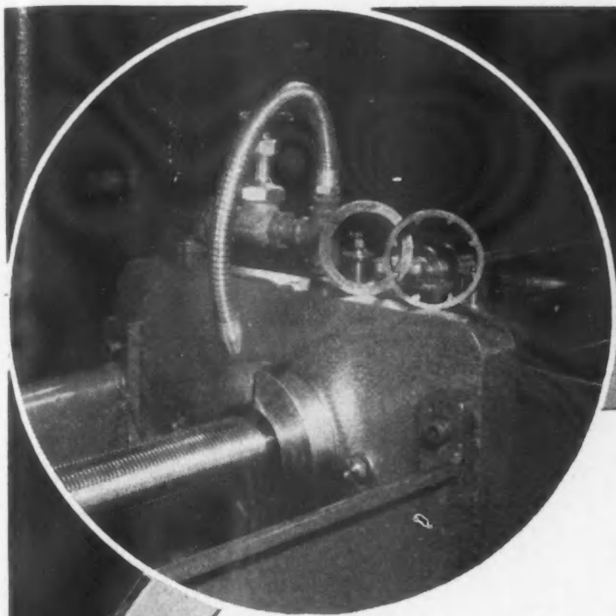
Aluminum alloy parts are pre-loaded on screen racks which rest on movable trucks. Once loaded, the trucks are rolled to the loading station of the conveyor where they are automatically attached to the conveyor and carried through a cleaning and chromodizing process, over driers, into a paint tank and finally back across the top of the machine.

Along the conveyor route are five cleaning and chromodizing tanks, four of them containing 3500 gallons of liquid each and the first of the series ontaining upwards of 5000 gallons. The conveyor carries the loaded racks, (aluminum alloy parts are attached to the screen racks by hooks,) from one tank to another. The stopping time in each tank is set for from two to three minutes.

The first tank, the only tank of the cycle with a capacity more than 3500 gallons, is filled with an alkaline cleaner which degreases the metal. The conveyor has two stations in the degreaser, and two racks are processed in the large tank at one time. Degreasing requires a longer processing time than other stations in the cycle. The alkaline cleaner is kept at a temperature of from 180 to 200 F and the time required for the complete process is six minutes.

No. 2 tank in the sequence furnishes a hot water rinse, No. 3 station a chromic acid dip, No. 4 station a hot water rinse and No. 5 station another rinse in clear water. The No. 6 station dries the parts by hot air from a piping system. No. 7 station is the paint dip, and the tank at this station is filled with 3500 gallons of zinc chromate primer.

Several racks fit into the drying station at one time and approximately



8 at a time

Today Lapointe broaches and broaching machines are producing more precision parts than previous methods of machining. Typical of these production installations are the .4L Broaching Machines at the Springfield Arsenal that are making the apertures for Garand rifles. Shown on the face plate of the machine above is the ring before and after spline broaching. This ring is made from a forging ground to correct thickness. It is then spline broached and each finished ring makes 8 parts. This 8-at-a-time production accounts for 2,240 component parts per hour in one single high speed operation.

ARMY E NAVY

The LAPOINTE Machine Tool Company

HUDSON, MASSACHUSETTS, U. S. A

15 minutes is consumed in traversing this station. The machine is set to process parts in each of the previous stations, with the exception of the first station of alkaline cleaner, for two minutes. Ninety seconds are required in administering the primer at No. 7 station.

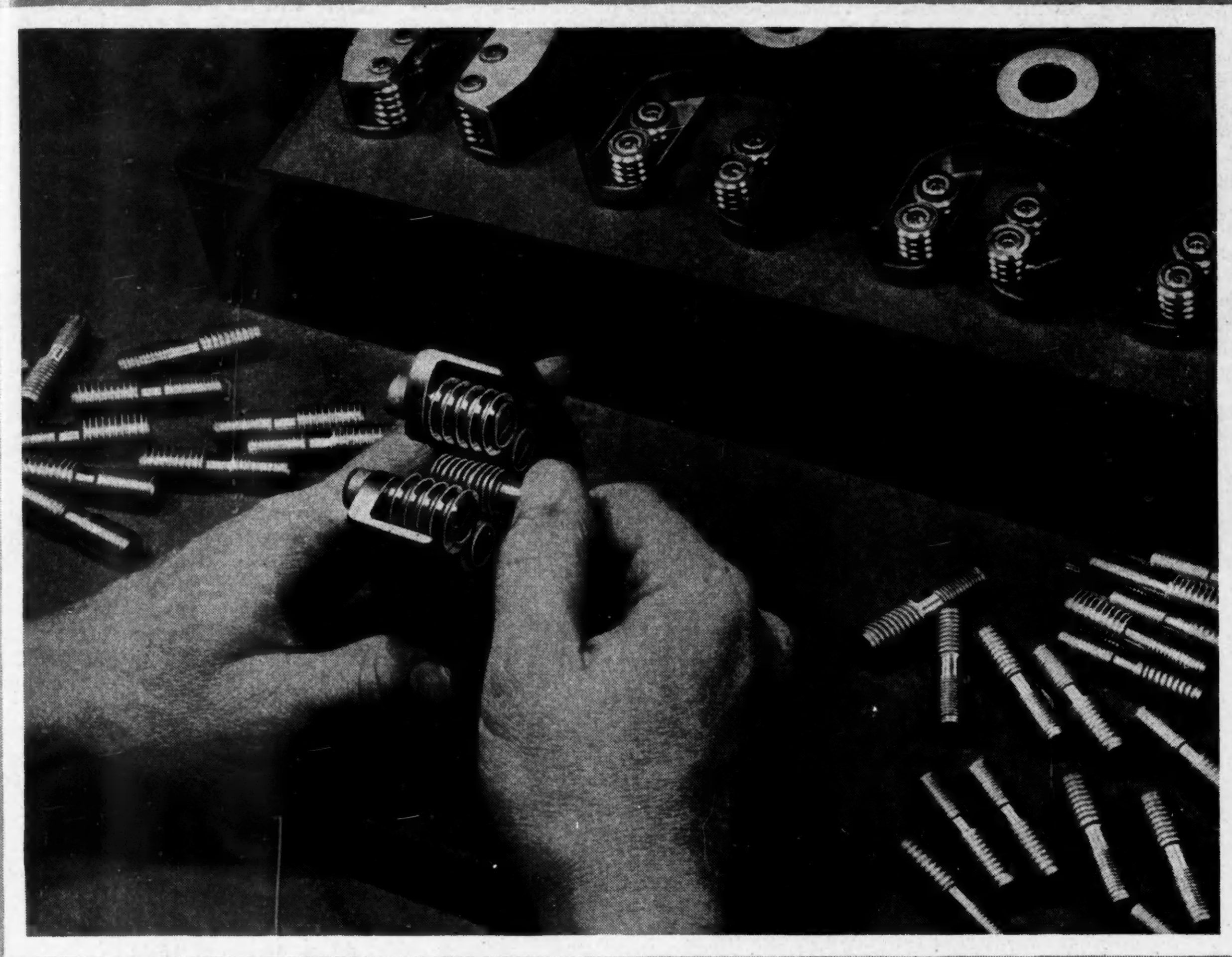
Between the tanks and the return track is a flooring which prevents paint from dripping onto parts going through the processes of cleaning and chromodizing. The entire cycle consumes 72 minutes. It takes 34 minutes for a rack to leave the loading station and travel through the seven stations to the return track, and 38 minutes for the rack to complete the return route from the paint dip to the unloading station. This time is being reduced constantly.

Except for surface parts, by which is meant outside parts of fuselage, wings and empennage, processing done in the Chromodizing and Paint Dip Conveyor affords the metal all the treatment it gets. Surface parts of the ship go through the assembly lines after which they are twice completely cleaned, prepared and lacquered before being delivered to the Army.

One surface part on which a number of cleaning, prepping and repainting operations are done before it even reaches the assembly lines is the leading edge of the wing panel. Once the leading edge has been assembled into a sub unit of the wing panel, it is glazed, water-sanded until perfectly smooth, and then sprayed with a heavy gray surfacer. The thirteen operations necessary to preparing leading edges, which are in addition to the chromodizing and paint dipping process through which all of the individual parts of the leading edge have already passed, as follows:

1. Cleaning with brush-wash; 2. metal prep for better adhesion; 3. prime coat of zinc chromate; 4. drying oven for 50 minutes; 5. sprayed with one coat light gray, and sanding of surface; 6. drying oven for second 50 minute period; 7. glazing all seams, rivets and indentation; oven for drying; 8. sprayed with double crosscoat of sanding surface; 10. oven for drying; 11. water sanding with vibrating sanding machine, checkup for defects and additional glazing if necessary; 12. dried by blowers and thorough wiping off with cloth; 13. sprayed with one heavy-gray surfacer.

At the end of the wing assembly lines at Bell Aircraft Corp. the panels are camouflaged, also on a conveyor system. The wing panel is taken from the assembly lines and attached to jigs hanging from a monorail. On the monorail are 11 stations where the following operations are performed: 1. brush-wash entire outer skin surface; 2. leading edge checked and glazed where necessary; 3. masking of panels not requiring paint; 4. panel surface sprayed with one coat of zinc chromate primer; 5. spraying of Army insignia; 6. entire panel, excepting surfaces masked,



Throughout the rush of today's war production — and for many peace-time years before that — Pratt & Whitney Roll Thread Snap Gages have done yeoman service wherever small threaded parts have needed accurate, rapid gaging.

The Roll Thread Snap Gage is an old story to Pratt & Whitney . . . we have made thousands of them . . . for every phase of industry.

THROUGH ALL THE RUSH

This Vital Service Has Not Changed

ACCURACY cannot be rushed . . . not the kind of accuracy that Pratt & Whitney has supplied to industry these past 83 years.

We know full well the desperate pressure and rush of war production . . . we've served faithfully through many of our country's wars. But never in any of these emergencies has the Pratt & Whitney standard of accuracy been sacrificed for speed. Enlarge our facilities . . . yes. Add and train thousands more men . . . yes. But lower our standard of accuracy . . . never. Through peace and war, Pratt & Whitney machine tools, small tools, and gages are made to one rigid standard of accuracy which has never changed.

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Division Niles-Bement-Pond Company

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sprayed with coat of camouflage; 7. decalcomania and identification markings; 8. unmasked, touching up around wheel-wheels, doors, etc. The monorail then carries the panels through the various cleaning, priming and painting stations directly to the shipping room where they are sent to the assembly plant and attached to fuselages.

At Bell Aircraft's assembly plant, all individual parts have already gone through the chromodizing and painting machine prior to the time they are sub-assembled into units for the final assembly lines. The lower section of the fuselage, assembled as a unit in the last stations of sub-assembly, is sprayed with one coat of camouflage lacquer before it is placed on the constant motion lines for final assembly. Cowlings and other outer surfaces added to the ship on the final assembly lines are camouflaged in spray booths located in the sub-assembly department.

When an Airacobra is completed and put through test flights, it is hauled into a hanger adjacent to the company's airport and is given another thorough camouflage spray just prior to the time it is delivered to the Army. The camouflage administered in the airport hanger is the final finishing treatment given the plane.

The inherently low resistance to corrosion which was characteristic of magnesium alloys a few years ago has been constantly improved, but these alloys must still be given a good surface treatment and first class organic protection before they perform satisfactorily in service. Chrome pickling is one of the most common surface treatments. The solution composition used is 1.5 lb sodium dichromate, 1.5 pints concentrated nitric acid (sp. gr. 1.42), and water to make one gallon. Immersion in the solution is from one to two minutes and the bath is operated at normal room temperature. Paint coatings are applied immediately after parts have been rinsed in cold water and hot water, and dried. The cleaning cycle for the parts prior to the treatment is degrease, hot alkaline dip, hot water rinse, cold water rinse.

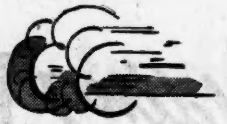
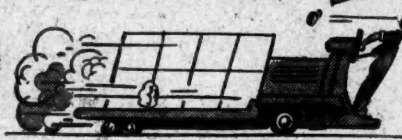
A conveyor installed in the cadmium plating department has acted to speed up production. Iron and copper base alloys require cadmium plating for protection against rust and corrosion. Much material reaching the department has been heat-treated and, therefore, must be shot blasted to remove heavy scale and oxide.

The cleaning and plating cycle for parts after they reach the plating department follows: degreasing, anodic clean, hot-water rinse, cold water rinse, acid dip in solution 20 per cent muriatic acid, and cold water rinse. From the cleaning process, parts are placed on the semi-automatic conveyor for final plating. The conveyor racks are 18 ft. by 30 ft. and hold up to 50 parts. The department has 25 such racks, one of which follows the other long-narrow plating tank. The conveyor cycle is completed in 20 minutes.

Parts to be painted after plating require an additional rinse of not less than two minutes in a five-per cent solution of chromic acid. The additional rinse neutralizes traces of alkali remaining in the pores after plating and increases paint adhesion. Ovens dry all plated parts before they leave the department.

A monorail carries steel parts on racks or in baskets through the following cycle: degreasing, soda tanks, rinse in hot water, rinse in cold water, muriatic acid bath, and cold water rinse. The steel parts are removed from the monorail by hand and placed on the semi-automatic conveyor for the plating process.

Special treatment is necessary for sealed-end tubings that have been plated. After these tubings have been taken from the drying ovens, lenseed oil is forced through a small hole drilled in one end of the tube. The oiling process eliminates any corrosion which might be caused by dampness or any foreign solution which might have worked inside of the sealed tubing. When the oil is drained from tubing, a film remains to give the hidden surface additional protection against corrosion. The tube is resealed with a drive screw.

WHAT WAS THAT  THAT JUST WENT BY? NOT A FOUR  GENERAL BUT ANOTHER  LOAD OF WAR EQUIPMENT THAT WAS PUT TOGETHER  IN RECORD TIME SINCE . . . THAT FAST-DRIVING RECESSED HEAD SCREW  CAME ON THE JOB. . . . .

IT'S PHILLIPS . . .

THE ENGINEERED RECESS

Sure — the news is swell! But the war isn't over yet. The heat's still on — and production speed is as vital as ever.

One of the surest ways to get more speed in your assembly operations is to put Phillips Recessed Head Screws in the hands of your workers. Hundreds of plants all over the country have standardized on the Phillips screw — and the results have been spectacular. Driving speed has often been doubled. Vital man hours have been saved. Production has been greatly increased — thanks to the Phillips Recess which makes power or spiral driving practical.

Some advantages of Phillips Recessed Head Screws are listed here. Check them against slotted head screws — or any other type you may be using. You'll quickly see why it costs less to use screws with the Phillips Recessed Head.

TO MAKE WARTIME QUOTAS AND PEACETIME PROFITS

Faster Starting: Driver point automatically centers in the Phillips Recess . . . fits snugly. Fumbling, wobbly starts, slant driving are eliminated. Work is made trouble-proof for green hands.

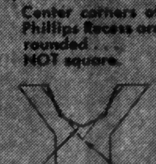
Faster Driving: Spiral and power driving are made practical. Driver won't slip from recess to spoil material or injure worker. (Average time saving is 50%.)

Easier Driving: Turning power is fully utilized. Workers maintain speed without tiring.

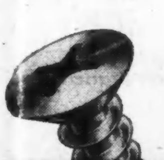
Better Fastening: Screws are set-up uniformly tight, without burring or breaking of screw heads. The job is stronger, and the ornamental recess adds to appearance.

IDENTIFY IT!

Center corners of Phillips Recess are rounded . . . NOT square.



Bottom of Phillips Recess is nearly flat . . . NOT tapered to a sharp point.



PHILLIPS *Recessed Head* SCREWS

WOOD SCREWS · MACHINE SCREWS · SELF-TAPPING SCREWS · STOVE BOLTS

23 SOURCES

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The Bristol Co., Waterbury, Conn.
Central Screw Co., Chicago, Ill.
Chandler Products Corp., Cleveland, Ohio
Continental Screw Co., New Bedford, Mass.
The Corbin Screw Corp., New Britain, Conn.
General Screw Mfg. Co., Chicago, Ill.
The H. M. Harper Co., Chicago, Ill.
International Screw Co., Detroit, Mich.
The Lamson & Sessions Co., Cleveland, Ohio
Milford Rivet and Machine Co., Milford, Conn.
The National Screw & Mfg. Co., Cleveland, Ohio
New England Screw Co., Keene, N. H.
The Charles Parker Co., Meriden, Conn.
Parker-Kalon Corp., New York, N. Y.
Pawtucket Screw Co., Pawtucket, R. I.
Pheoll Manufacturing Co., Chicago, Ill.
Reading Screw Co., Norristown, Pa.
Russell Burdsall & Ward Bolt & Nut Co., Port Chester, N. Y.
Scovill Manufacturing Co., Waterville, Conn.
Shakeproof Inc., Chicago, Ill.
The Southington Hardware Mfg. Co., Southington, Conn.
Whitney Screw Corp., Nashua, N. H.

What happens when your hat comes down?

SOMEDAY, a group of grim-faced men will walk stiffly into a room, sit down at a table, sign a piece of paper—and the War will be over.

That'll be quite a day. It doesn't take much imagination to picture the way the hats will be tossed into the air all over America on *that* day.

But what about the day after?

What happens when the tumult and the shouting have died, and all of us turn back to the job of actually making this country the wonderful place we've dreamed it would be?

What happens to *you* "after the War?"

No man knows just what's going to happen then. But we know one thing that must *not* happen:

We must *not* have a postwar America fumbling to restore an out-of-gear economy, staggering under a burden of idle factories and idle men, wracked with internal dissension and stricken with poverty and want.

We must *not* have breadlines and vacant farms and jobless, tired men in Army overcoats tramping city streets.

That is why we must buy War Bonds—now.

For every time you buy a Bond, you not only help finance the War. You help to build up a vast reserve of postwar buying power. Buying power that can mean millions of postwar jobs making billions of dollars' worth of postwar goods and a healthy, prosperous, strong America in which there'll be a richer, happier living for every one of us.

To protect your Country, your family, and your job *after* the War—*buy War Bonds now!*

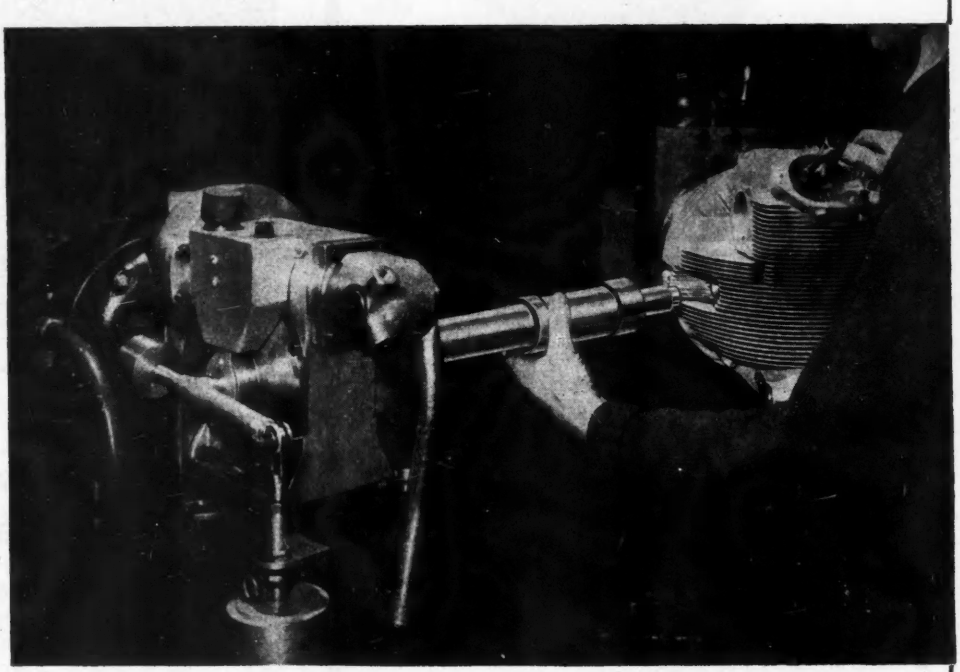
Let's all KEEP BACKING THE ATTACK!

The Treasury Department acknowledges with appreciation the publication of this message

YOU **CAN** "SEAT YOUR BUSHING INSERTS"

Gas-Tight

and without damage to threads . . .



In this modern mechanism, a bushing is fed to the adapter; the sleeve advanced to where the bushing enters the hole. At 100 R.P.M. the bushing is mechanically spun until within a few threads of the bottom of the hole. At low speed, bushing is driven firmly against its seat until correct torque has been reached. The Scandia torque principle prevents over-tightening of inserts, thereby eliminating the danger of cracked cylinder-heads during flight.

Scandia's TORQUE-MACHINES are doing it—DAILY for America's finest Aircraft . . .*

SCANDIA CAN SUPPLY OUTSTANDING AUTOMOTIVE TORQUE MACHINERY FOR TINY STUDS TO GIANT BOLTS!

There is a definite advance toward economy and speedier production for Post-war automotive and aviation fields now being *demonstrated* under actual fast-production conditions in the building of motors for American aircraft. The time to acquire these improved units is *now! Write for information . . .*

* Manufactured under BRONANDER Patents.

Scandia MANUFACTURING CO.

NORTH ARLINGTON NEW JERSEY

There are over SIXTY THOUSAND

SPERRY EXACTOR REMOTE CONTROLS in use!

The Sperry EXACTOR Hydraulic Remote Control is a simple, unique, single-tube system designed to control mechanisms over distances up to 200 feet. The more than 60,000 EXACTORS in operation today, solving the remote control requirements of design engineers in many fields, are proof of the thorough engineering and trouble-free design incorporated in this system.

Positive control, through a single tube

It is accurate to a fraction of a degree and entirely self-contained, reproducing applied motion without the aid of an auxiliary source of power. It presents no installation problem, because both the Transmitter and Receiver are compact and light in weight, and the tube which connects them can be *bent around* obstacles easily. Vibration does not interfere with its positive, reliable action and means is provided for periodic temperature compensation.

If you have a remote control problem — in the railroad, marine, automotive, aviation, or any of the industrial fields — you will want our completely descriptive booklet. Send for it today.

The Sperry EXACTOR HYDRAULIC REMOTE CONTROL is rated at 400 inch-pounds in one direction, through 55° of motion, and 125 inch-pounds on the return.

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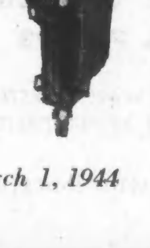

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Gentlemen: Please send me, at no cost, a copy of your Bulletin 78-D containing complete details on your EXACTOR HYDRAULIC REMOTE CONTROL.

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UAW-CIO Loses in NLRB Polls at Some Plants

(Continued from page 45)

In its drive to increase membership in the aircraft industry, the UAW-CIO also won an election at the Fisher Aircraft No. 2 plant in Cleveland by gaining 87 per cent of the ballots and at the Bendix Aviation Corp. plant at North Hollywood, Cal., where it received 64 per cent compared to 31 per cent for the IAM. The UAW-CIO also is seeking bargaining elections in the Bell Bomber plant at Marietta, Ga., and the Vultee plant at Allentown, Pa.

Although they have been rivals on the ballot in a number of recent NLRB elections, the UAW-CIO and the International Association of Machinists (AFL) have signed a pact banning raids by either organization in any plant where the other organization has been established by contract or by certification of the NLRB. H. W. Brown, president, headed the IAM signers at this Chicago amity meeting, while R. J. Thomas, president, led the UAW-CIO delegation.

Despite the fact that a House Naval Affairs sub-committee recommended his ouster as president of Local 365, UAW-CIO, at the Brewster Aeronautical Corp. plant in Long Island City after an investigation, Thomas de Lorenzo recently was re-elected to his fourth term as president of the local by a 1,000-vote majority. In its report on Brewster's inability to meet production schedules, the House committee said in a report, "It is plain that the major responsibility for the failure of production at Brewster rests with the short-sighted union leaders who, insisting upon the exercise of prerogatives which they never should have had, impeded production by strikes, slowdowns, work stoppages and organized loafing. In this they do no service to their country or to labor."

Reduction of labor turnover in West Coast plants also has been an important factor in greater productivity. The quit rate of those who voluntarily leave their employment has dropped continuously in recent months. In seven major Pacific Coast aircraft plants, the quit rate dropped from 7.18 per cent in September to 5.79 per cent in October, 5.36 per cent in November and a further decline in December. During November these companies lost only 16,548 employes compared to an average of 22,897 monthly for July, August and September.

The National WLB recently upheld the Chrysler Corp. in the discharge of two UAW-CIO shop stewards at the Dodge Truck plant who instigated a work stoppage on the loading dock in June, 1942, over the employment of 20 Negroes. The union charged that the dispute was over inter-plant transfers and promotions and that the racial issue was raised to "embarrass the union."